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LONDON GUARANTEE BUILDING
Michigan Avenue at Wacker Drive
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finish

MONTHLY TRADE PUBLICATION
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The only independently published trade publication devoted exclusively to Porcelain Enameling and Ceramic Finishing on metal.

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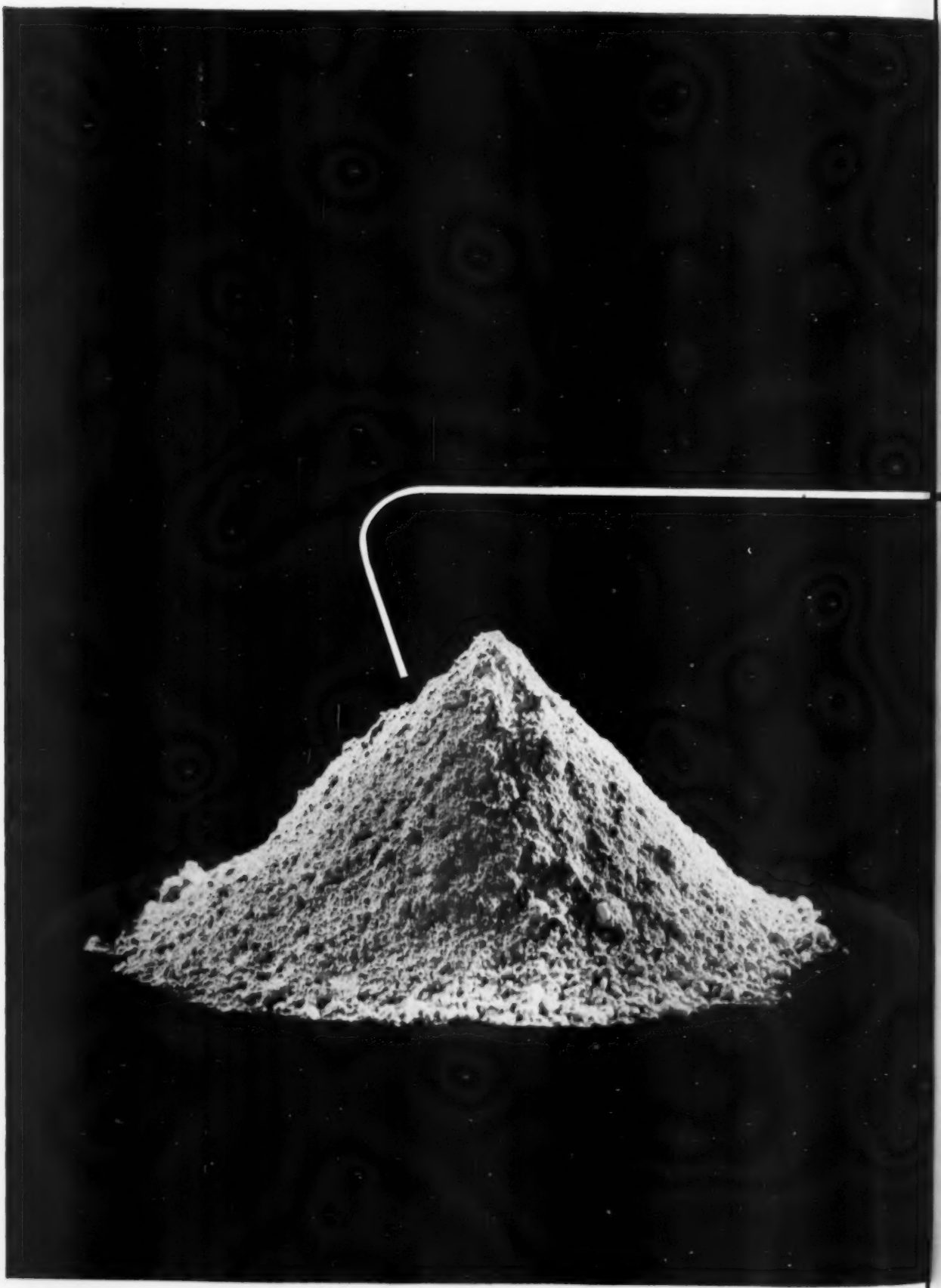

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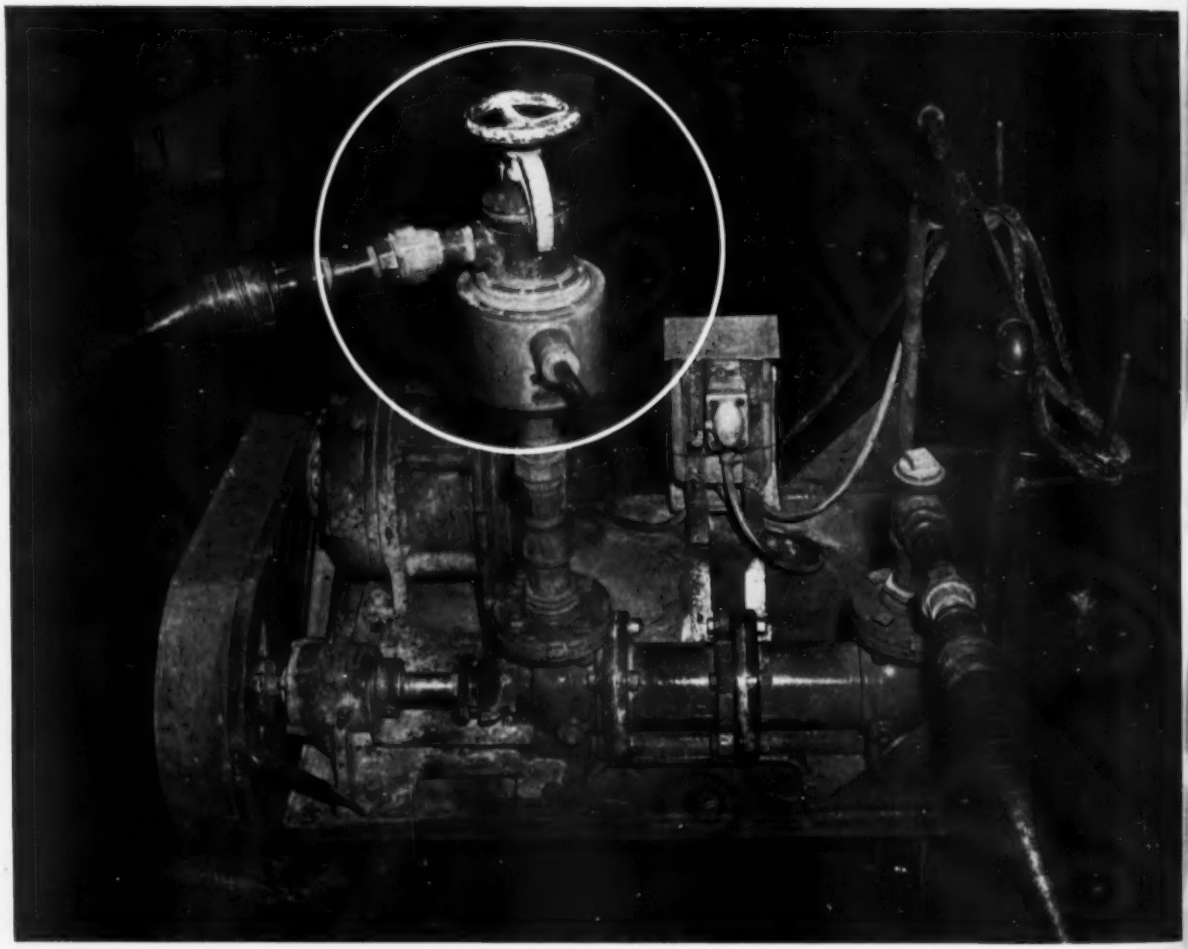

A pipe line type FerroFilter used in a complete assembly for gravity unloading of mills and pumping clean slip to overhead storage tanks at Kalamazoo Stove & Furnace Co., Kalamazoo, Mich.

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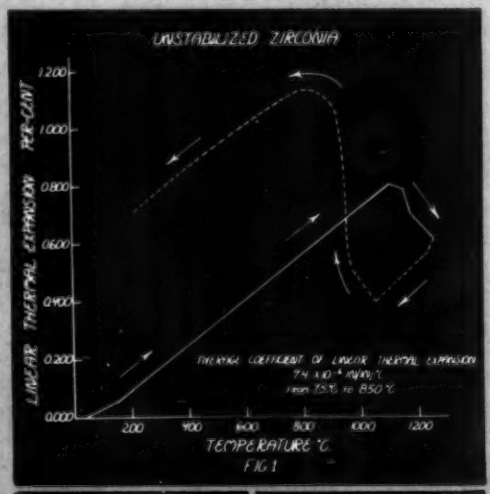

FIG 1

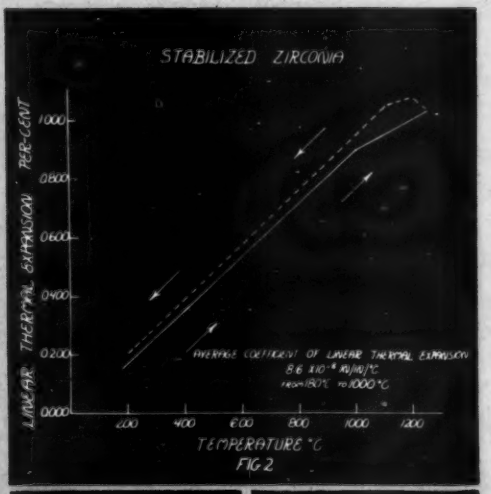

FIG 2

Unstabilized crucible cracked badly after one cycle of air quenching from 15 minutes at 2800° F.

Crucible of stabilized zirconia did not fail after more than 20 such cycles.

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A Guided Tour of The Merchandise Mart starting from the Main Lobby. This group included well-to-do home-owners from nine states.

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Beginning Sunday, March 14, The Merchandise Mart launched a newspaper, magazine and radio campaign inviting the public to visit, by Guided Tour, representative exhibits of home furnishings in this greatest of Market Centers.

The response was instantaneous. Our switchboard was deluged with advance reservations. Our staff of guides immediately found themselves operating at capacity. Additional guides are being trained to handle the growing volume of visitors. And—most important—the great majority of these visitors, when they finish their tours, are live prospects for the merchandise you have to sell!

Retailers approve this broadgauged plan. They realize, as do our exhibitors, that these Tours definitely stimulate public interest in home furnishings and household equipment and thus benefit the entire industry.

IMPORTANT NOTICE

No Guided Tours for the public for the period preceding and during
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We have complete data on the proper use of this material as a smelter addition or as a mill addition for decreasing firing temperatures on hard ground coat frits.

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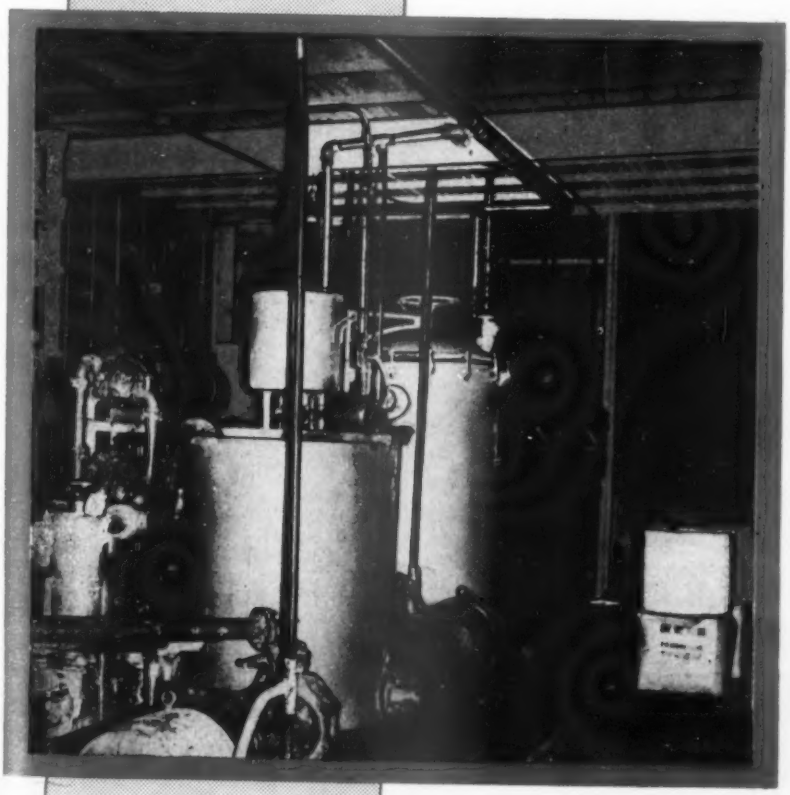
To obtain quality porcelain enameling on a production basis requires pickling room solutions that are clean. The presence of impurities in solutions means an increase in the amount of rejects. Proper filtration is the economical way to increase your production and keep it on a quality basis. Porcelain enameling plants that operate on a large scale day in and day out, know the value of keeping their solutions free of impurities. That is why Industrial Filters are the first choice of enamelers who are quality minded.



At left — Typical installation of Industrial Filter system for enameling plants.

This arrangement consists of filter, pumping unit, primer-strainer unit, mixing tank, control valves, fittings and piping.

These features facilitate the convenient use of filter aids and purifying agents, making it an ideal continuous filtration system, and equally as effective for intermittent filtering. Systems are provided for all solution requirements.

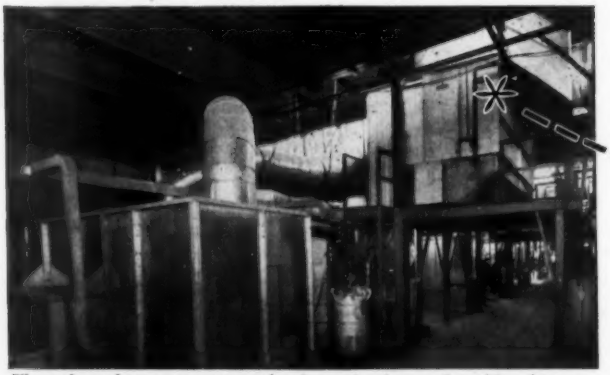
For 20 years "Industrial" has been building filters that have enjoyed an outstanding reputation for dependability, low upkeep cost, long life and bed rock operating economy. That is why so many enamelers say "I prefer the Industrial way."

INDUSTRIAL FILTER & PUMP MFG. CO.

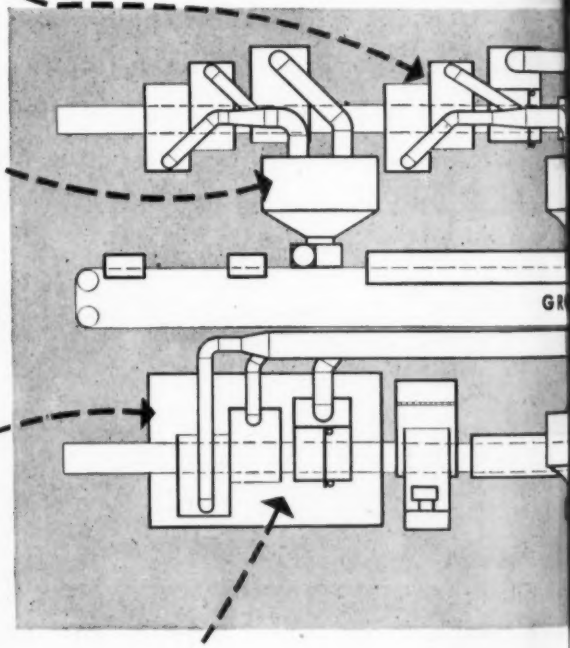
1621-39 WEST CARROLL AVENUE • CHICAGO 12, ILLINOIS • TELEPHONE SEELEY 3631-3-4-5

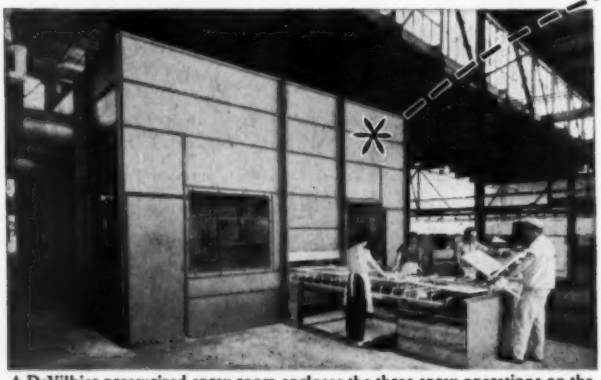
Outside air is filtered free of dust and dirt in this DeVilbiss overhead air replacement system. This is one of three air replacement units serving the entire enameling department. The battery of six spray booths provide the four hand and two automatic coating operations on the ground coat line.

Following the spray operations on both the ground coat and cover coat lines the conveyor proceeds through a drying oven to the unloading station shown above.



Three elevated common water wash exhaust chambers such as this unit serve a total of nine spray booths by means of interconnecting ducts. The combination of dry and wet exhaust chambers in DeVilbiss ceramic booths arrest approximately 98% of the oversprayed solids.





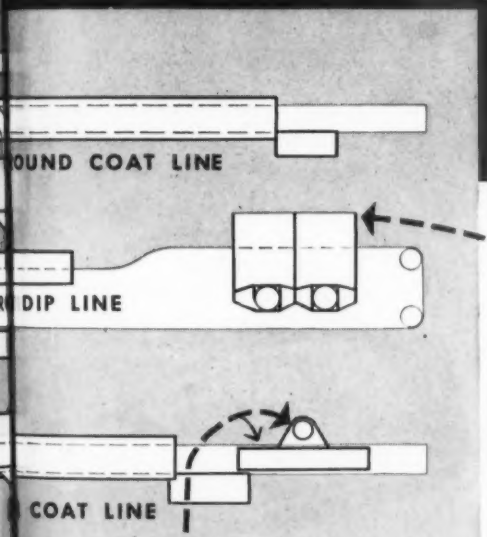
A DeVilbiss pressurized spray room encloses the three spray operations on the cover coat line to assure the finest possible finish free of flaws caused by dirt and dust.

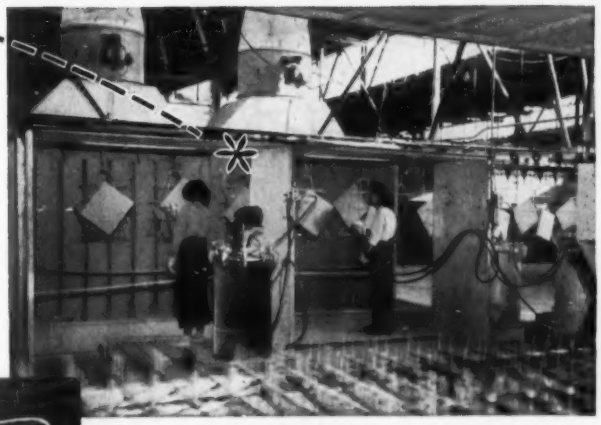
Inside the pressurized room, two edging booths and a high speed DeVilbiss automatic transverse machine spray a uniform, thorough covering coat as the parts travel along the 150 foot conveyor.

✱ Here is another impressive example of the complete and specialized service rendered by DeVilbiss. Dixie Foundry's new porcelain enameling department at Cleveland, Tennessee, is DeVilbiss-engineered and DeVilbiss-coordinated throughout. With each step of the enamel application integrated into a unified system, processing is practically automatic—finer, more uniform finishes are obtained—more pieces per hour are produced—and costs are low because handling is reduced to the minimum.

ANOTHER * DEVILBISS

Complete PORCELAIN ENAMELING SYSTEM





Tandem DeVilbiss booths located on the ground coat dip line provide the facilities for reinforcing and stippling parts as they leave the drying oven after dripping.

Brushing without drifting dust is accomplished by the DeVilbiss downdraft exhaust under the conveyor at the brushing station. Overhead, the air replacement unit supplies clean, fresh, outside air to the workers.

Have your enameling department analyzed by a DeVilbiss engineer. There is no obligation, and more than likely he can show you short cuts to finer quality, greater production and lower costs.

THE DeVILBISS COMPANY • Toledo 1, Ohio

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WITH SAFETY!

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PORCELFRIT
"The Plant Tested Frit"

IT'S PLANT TESTING that gives you the GREEN LIGHT...

PORCELFRIT puts you out ahead of the traffic!

There are three simple, sound reasons why this is so. First, it is the result of thorough and continuing laboratory experiments. Second, it is tested under conditions of actual use right here in our own job enameling plant, so the guesswork is taken out. Third, at no cost to you, our trained ceramic engineers will visit your plant and make sure that PORCELFRIT works properly for *you*.

Scores of leading manufacturers have convinced themselves that PORCELFRIT gives them a better product. Why not profit by their experience? Let us show you *why* they're so well satisfied.

INGRAM-RICHARDSON MFG. CO., OF INDIANA, INC.

OFFICES, LABORATORY AND PLANT, FRANKFORT, INDIANA

THE Finish Line

ARCHITECTURAL PORCELAIN IS ON THE WAY — and any who doubt this statement may put this page in their follow-up file for June 1949 and check it for accuracy at that time. Naturally there are factors beyond the control of the producers of architectural porcelain enamel, or the consumer, which may have controlling effect. This includes supply of sheet metal, the general picture in the building field and labor conditions in the building trades.

The largest potential market

There have been those, both within and outside the industry, who have been inclined to pooh-pooh architectural porcelain enamel as a product that would ever become an outstanding factor in the over-all production figure of porcelain enameled metal. We say now, as we have said before, that properly handled—from fabrication, through finishing, through distribution, through installation—this comparatively new building material can absorb a greater percentage of the industry's production than any other single industry.

Commercial uses

Many, particularly in the architectural profession, have been inclined to associate porcelain enamel with the road-side restaurant and the gasoline filling station and question its proper use as a useful medium for larger structures. It is true that the product *is* the most effective obtainable for restaurants and filling stations, due to its outstanding qualities of brilliance, cleanliness, and durability. *(Meaning elimination of upkeep).*

Porcelain enamel is starting to get proper recognition

Indication of the fact that porcelain enamel is well started on the road to recognition may be read in the following quotation from an address before the American Society of Civil Engineers by J. P. H. Perry, vice president of the Turner Construction Company, on the subject "A look into the future of the building construction industry." The following paragraphs are from this address:

"One of the great changes that may be expected is the doing away with masonry walls, partly because of the opinion held by the public, and even by architects and engineers, about bricklayers. We will probably come to metal skin buildings. One is already contemplated on Park Avenue, New York, and the United Nations Headquarters, it is understood, have made elaborate studies of metal skins for their proposed buildings. The use of high-efficiency insulating materials as a backup for these skins, opens inviting vistas. High-tensile-strength glass, greater use of welding, plastics, phenol glues, all have a bearing on the building of the future.

"New architectural trend is noted.—A straw that is blowing about the country may be indicative of future buildings, not only as to materials, but as to architectural treatment or esthetics. By this straw in the wind, it meant the gasoline filling stations spread across the country in the thousands. The great oil companies are not missing any bets. They are erecting buildings which attract and are pleasing to the motoring public—which is America. The use of color, functional architecture, metal skins and enameled metals is rampant. If time proves that the public continues to like these features, there may be a demand for them in homes and larger buildings."

Porcelain enamel for homes

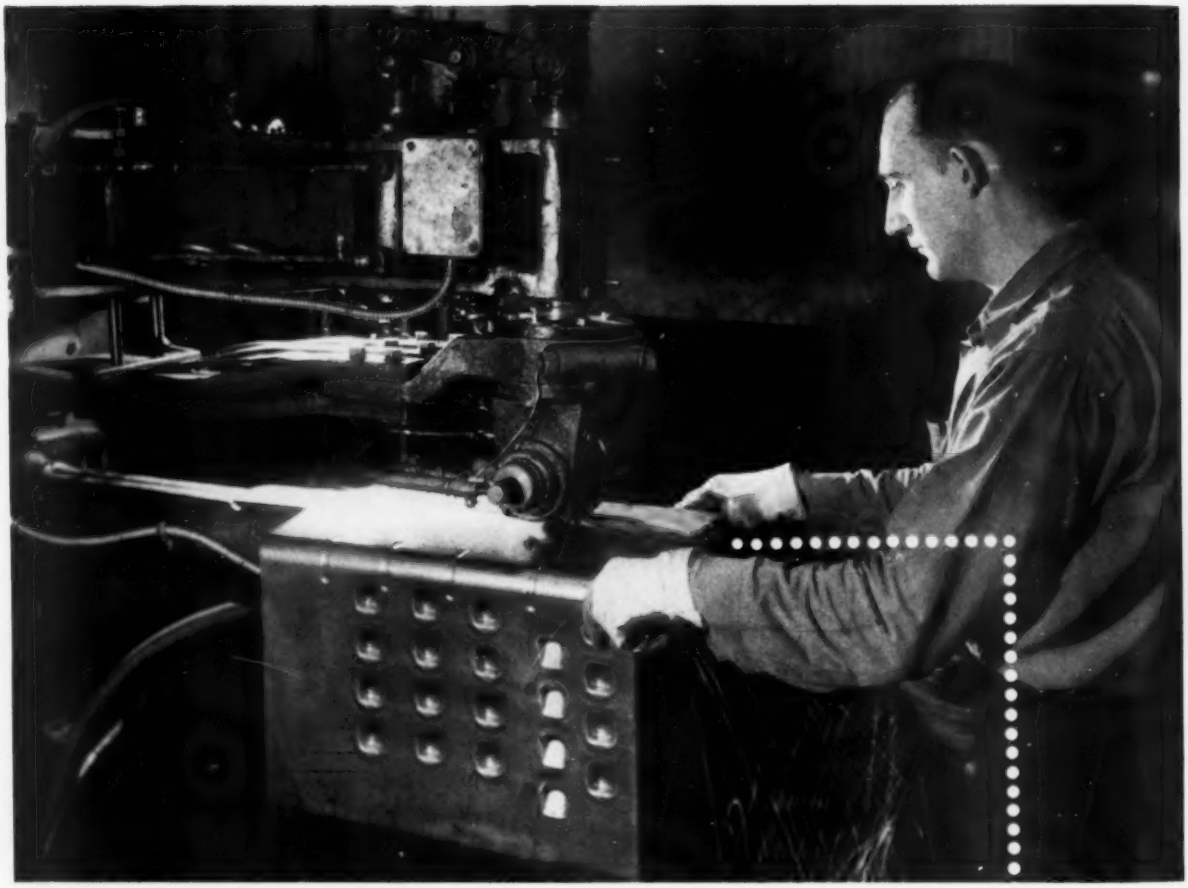
The dream of the porcelain enameled home is not new. It has been presented in print since the early '30's and the dream was expressed literally with homes at the Chicago World's Fair and with numerous other homes at that time. Today we see such companies as Lustron Corporation, Higgins, and others, planning the large scale production of these "dream homes."

Without question there are many obstacles to be overcome before porcelain enameled steel will be used universally as a building material, but it doesn't change the direction of the signs which are pointing so favorably for porcelain enamel.

If you are skeptical we again urge that you check this development in the building industry a year from now, particularly with regard to trends in commercial buildings.

Dana Chase

EDITOR AND PUBLISHER



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We are striving to increase our production of these quality sheets in order to meet the unusual demand for them. INLAND STEEL COMPANY, 38 S. Dearborn St., Chicago 3, Ill. Sales Offices: Chicago, Davenport, Detroit, Indianapolis, Kansas City, Milwaukee, New York, St. Louis, St. Paul.

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An early headache
becomes a practical movable building

history of the first porcelain enameled all-steel building and evidence of its practicability

By L. W. Ray • SUPERINTENDENT OF CONSTRUCTION, WHITE CASTLE SYSTEM, INC.

Exclusive feature finish

This year marks the 20th anniversary of the erection of the first porcelain enamel White Castle. According to all the records we have been able to unearth, never before had porcelain enamel been successfully used as an architectural material.

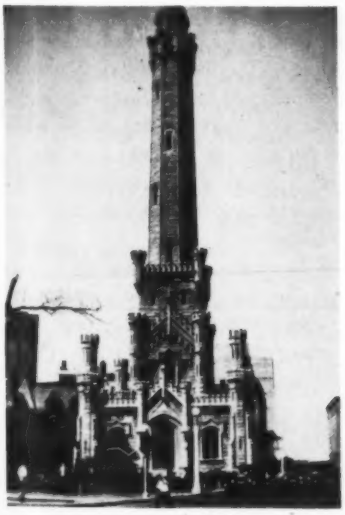
Since 1928, there have been 52 porcelain enamel buildings of this same type of construction and under the same patents erected in the United States, and following the inactive war years, more are again being built. They have solved the problem of providing a structure impervious to weather and decay, durable and lasting, having practically no maintenance cost, and yet being mobile to the extent that nine of these buildings have been moved from their original locations—two of them twice.

The production of that first porcelain enamel building covered several years of seeking and searching and of trial and error. The achievement was made possible only because of the vision of E. W. "Billy" Ingram, president of White Castle System, Inc., his boundless faith, his untiring patience and his relentless determination to find a type of building for which there was a commercial need but which had never been built.

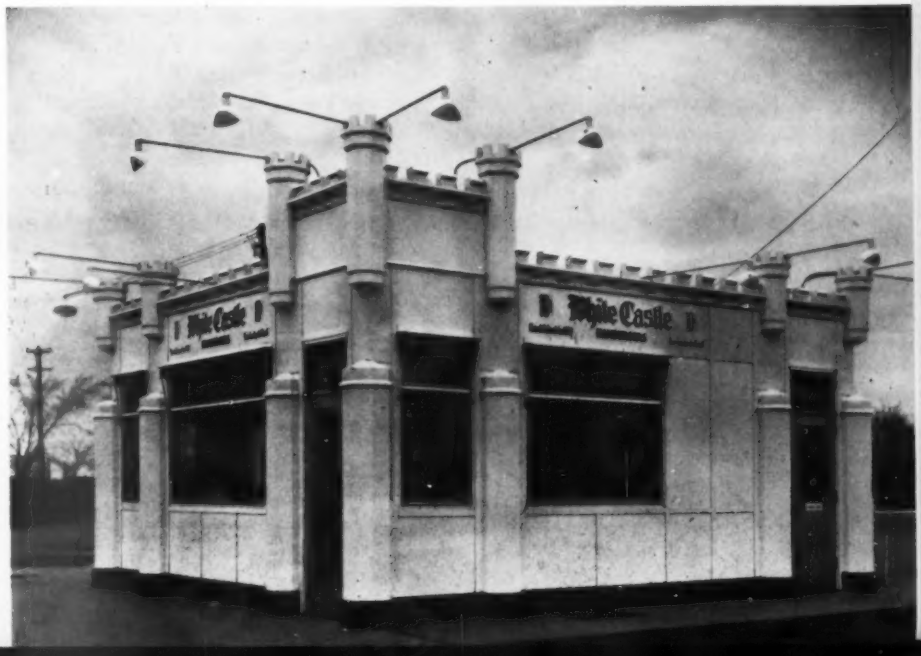
The vision began to take form in 1922 when Billy walked the streets of Omaha, Nebr., for more than a month trying to get somebody to give him a lease on a piece of property that offered possibilities as a location for a White Castle, which in those days were built of cement blocks.

"Every real estate man to whom I talked," Billy has told me, "referred me to someone else, and every owner told me he wouldn't consider tying up his property for longer than 30 days.

"The thought came to me of how valuable it would be to have a building that we could move so that we could take these 30-day leases and yet not lose our investment if we were required to vacate within a few months. I discussed this matter with a Mr. Carter of the Carter Sheet Metals Works of Omaha who had constructed a metal home. We discussed the idea of building an all-metal White Castle and drew up some



Above: The turrets of Chicago's water tower landmark solved the design problem for White Castles.



Right: This White Castle, located at Gratiot Avenue & 8 Mile Road, East Detroit, is one of 52 such porcelain enameled buildings erected since 1928.

Firm also erected other buildings.

Progress at 3:30 p.m. of second day.

Four days after project was begun.

plans for such a building. In substance, however, they resembled a galvanized iron garage and possessed neither practicability nor beauty of design."

It was about this time that Billy first talked to me about building a metal White Castle. I was engaged in the manufacture of truck and bus bodies in Wichita, Kansas, which was then the headquarters for the White Castle System, and had been building counters and other odd pieces of equipment for him in my shop.

In 1926, I joined the White Castle System to take over the development of fixtures and equipment, with intructions from Billy to concentrate on developing a movable steel building with interior and exterior finish of porcelain enamel.

Cement block, stucco, enameled brick — then porcelain enameled steel

From the original cement block buildings, construction of White Castles had progressed to stucco, and then, in 1925, to white enamel brick for exterior finish. The idea of a porcelain enamel building came from a brick White Castle, erected in St. Louis in 1925, which was lined on the inside with porcelain. It probably was the first installation of this kind in the country.

The enamel was made by a company in Granite City, Ill., by the old sifting method; the manufacturer never knew how much enamel he had on a sheet. In installing the enamel, the joints were covered by trim strips, about 2 inches wide and ¼ inches in depth, with screw holes about every 8 inches for securing them to wood furring strips with ordinary flathead screws.

Editor's Note:

Due to the strong current interest in the use of porcelain enameled steel for architectural purposes, we feel that *finish* readers will be interested in a review of some of the early work which preceded the present utilization of porcelain enamel for both residential and commercial building purposes. We believe you will be interested in following Mr. Ray's description of the early headaches and what he terms "screw ball" ideas to the point of present utilization of porcelain enamel as a practical building material.

The job looked beautiful when completed, as it was white and could easily be kept clean, which was one on the main reasons for this particular finish. However, the mechanic applying the enamel knew nothing of its characteristics and pulled the screws too tight, with the result that vibration from the trucks passing by on the street caused the enamel to break off. Within a week the walls looked as though someone had stood back and shot at them with a splatter gun.

Even though many mistakes were made on this first installation, Mr. Ingram believed he was on the right track and decided that all future buildings would be lined with enamel.

The structural design problem

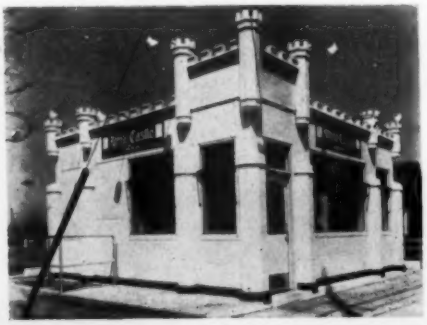
The first job in developing the desired steel buildings was to work out the structural parts. This was done by the building of a model, one-fourth actual size and so designed that the sections for the corners and the walls were interchangeable to make possible the shifting of doors and windows to meet the needs of specific locations.

We then started out to find materials suitable for such a building and discovered that there was nothing on the market like the shapes we had designed. The old traditional method of framing by using angle iron, I-beams and heavy channels defeated our purpose, as we were trying to evolve a building that would be light in weight to facilitate moving and handling.

In October, 1926, I went to St. Louis to see Ed Foley, then with American Rolling Mill Company and later associated with Chicago Vitreous Enamel Product Company. Another representative of American Rolling Mill Company, Fred Dechant, happened to be in St. Louis

A. Wichita, Kansas.

B. Louisville, Kentucky.



C. St. Louis, Missouri.

In a week the job is completed.

Office is finished in porcelain enamel.

Service room also of porcelain enamel.

that day, and he suggested that I go to Middletown, Ohio, and consult with his superior, Bennett Chapple, who was interested in the development of enamel for structural use.

The suggested trip to Middletown was made in January, 1927, and the information obtained was that Berger Manufacturing Company, Canton, Ohio, was making a light metal stud known as metal lumber. A trip to Canton brought assurance that our proposed building could be framed in this material at a reasonable cost, so an order was placed to cover the erection of one building.

It can't be done!

With several ideas in mind about the exterior finish, Billy Ingram and I went to Chicago and called on Grable B. Weber, then sales manager for Benjamin Electric Company. From the office we went to the company's plant in Des Plaines where we met the superintendent, L. R. "Bill" Tansley, who for the past several years has been associated with the White Castle System as director of factory operations.

It was during my talk with Bill Tansley that I contracted my first real headache, as he exploded, like so much dynamite, the ideas I then had of a porcelain enamel finish. The idea I had worked out was impractical from an enameling standpoint. As a substitute, I was offered a porcelain tile. This finish looked practical, and after several weeks of corresponding and another trip to Chicago, we placed an order for enough tile to complete one building.

Many White Castles have been moved from their original locations and erected on other sites, including those shown in the bottom row of pictures:

A. The first (1928) porcelain enamel White Castle is shown at its third location in Wichita. The interchangeable feature of structural parts is illustrated here; in the original setup the front door was on the side, here it is seen on the end.

B. In Louisville, this White Castle was first erected in 1935, and moved to its present site in October, 1946.

C. In St. Louis, this White Castle was moved to its third and present site in 1945 — 10 years after it was first opened for business.

D. This White Castle made an interstate trip in 1939 when it was ferried across New York Bay from East Orange, N. J., to its present Long Island location. It was first erected in 1931.

E. In Minneapolis, this White Castle was moved to its second and present location in November, 1947, twelve years after it was first erected.

F. Ten years after it was first opened for business, this White Castle was moved to its second location in Cincinnati in 1945.

About July 1, 1927, our building arrived in Wichita from Canton, along with the tile from Chicago. A location was procured at Douglas and Hillside Avenues. After the steel work was completed, we attached a covering of metal lath over the entire exterior as a reinforcement and then applied the tile.

This was the first step, but we could readily see that we had not achieved our goal at this point, and we set out to develop something entirely new.

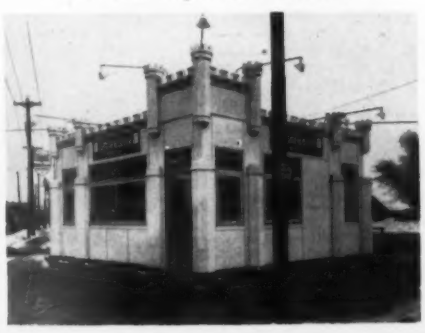
After working on several ideas that did not materialize, early in 1928, I struck on the idea of the locking device and studs formed to receive the panels and frames, which was to become our standard construction. I proceeded to Chicago where I placed the proposition before Bill Tansley, and this time he informed me that the idea was a good one and entirely practical from an engineering standpoint.

View of Chicago landmark solves design problem

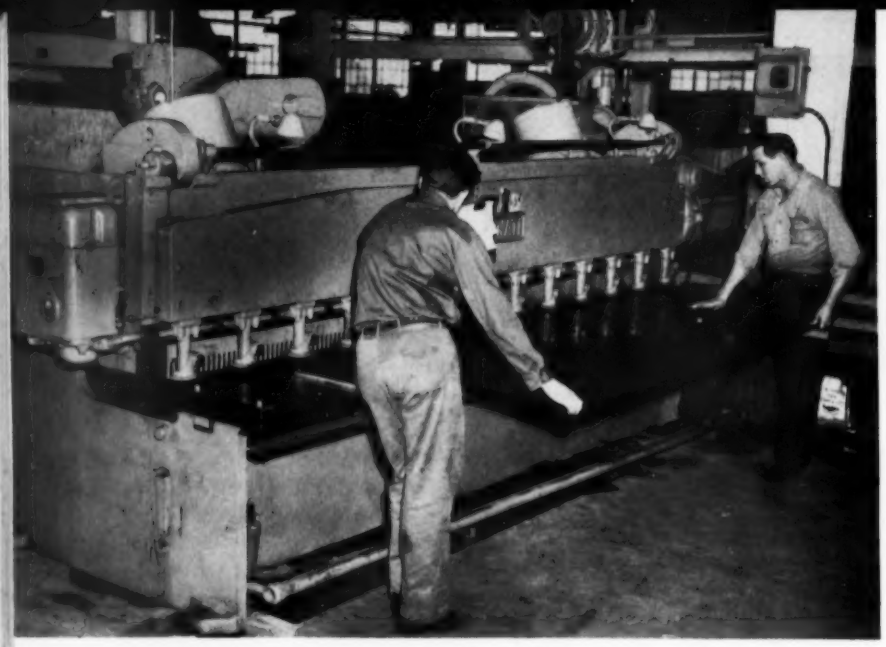
We had not yet decided on a design. Mr. Ingram wanted the building to have some resemblance to a castle to carry out the company name, but we did not know how to reproduce it in enamel. One Sunday while in Chicago, I took a stroll up Michigan Avenue—and ahead of me was the old Chicago water tower. I

D. Long Island, New York.

E. Minneapolis, Minnesota.



F. Cincinnati, Ohio.



A power shear, which will handle 3/16" x 12' steel sheets, is used to cut panels and shapes out of enameling iron sheets for White Castles.

knew, suddenly, that the design problem was solved if I could get the parts enameled that would produce a turret effect like the water tower. I went into a huddle with the men at the Benjamin Electric plant again, and they agreed that they could do everything that I wanted done.

Arrangements were made to build one complete building at the Benjamin plant, where instructions were issued to the heads of the various departments to work with me and do anything I asked them to do. I was assigned a draftsman, and as soon as the details for the various parts were completed we would start them through the factory.

The heads of all departments cooperated one hundred per cent, although I caused them many headaches and, perhaps, received plenty of "cussings" that I never heard about. I must give Bob Roadhouse, who was then foreman of the enameling room, credit for his patience and wholehearted cooperation. I had him scratching his head trying to do some of the "screwball things," as he used to call them, that I wanted done, but somehow he managed to do them all.

Trial by fire

We started work July 10, 1928, and on December 13 of that year the first all-metal porcelain enamel building was set up in a vacant lot so we could observe it through the winter and under various weather conditions.

During this time, the building received one test which was not according to schedule. Tar was being put on the roof and barrels of tar were close against the walls. They caught fire and burned for several hours, enveloping the building in a mass of flames and black tar smoke. After the fire was put out by the fire department, it was necessary only to wipe the building off and it stood out as shiny as ever. The fire did no damage, nor did the fire hose playing from all angles on the building get water inside.

After standing a six-month test successfully, the building was moved in June, 1929, to its first commercial location in the third block on South Broadway. In March, 1931, it was moved four blocks north to Broadway and First Street where it still stands. For the past ten years, however, it has been devoid of the corner tower, which is a distinguishing feature of White Castles, because it was sold at the time the White Castle System discontinued its operations in Wichita, and one stipulation of the sales was the removal of the tower to avoid confusion.

In 1930, we made a manufacturing connection with Sykes Metal Products Company, Chicago, for its plant in Logansport, Ind., with arrangements for the enameling to be done at Benjamin Electric. A number of changes were made in the structural parts that had a tendency to increase the building's strength and simplify erection work. The most important change was in the application of stainless steel metal to doors, frames and sash, thereby eliminating upkeep and adding richness and beauty to the general appearance.

Through 1931, seven buildings were fabricated by the Sykes Company and erected in St. Louis, New

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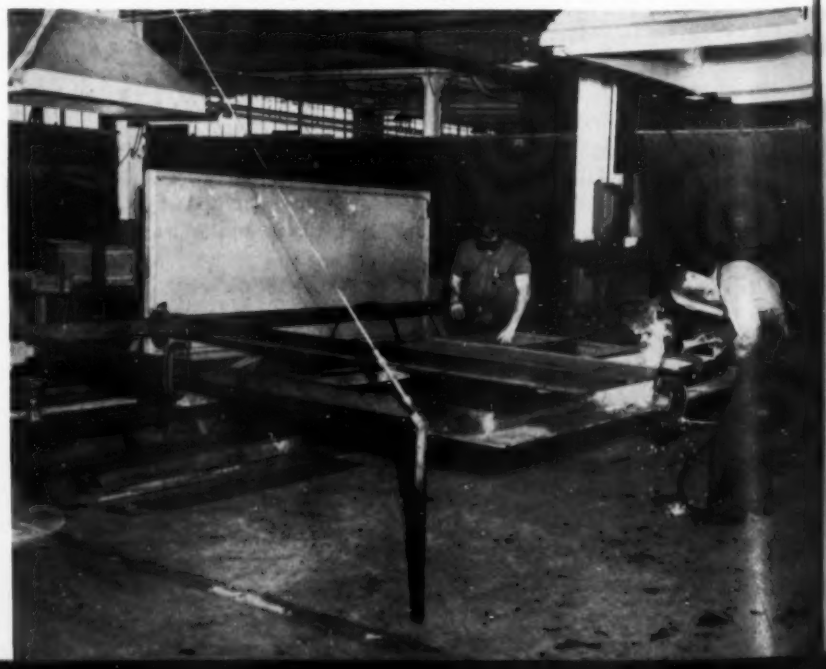
A welding jib is used in Porcelain Steel Buildings Company factory to weld the structural frame parts for the porcelain enamel White Castles.



The fundamentals of pyrometry

non technical treatment of a subject of interest to all enamelers

Part I

By W. H. Steinkamp • BROWN INSTRUMENT COMPANY, DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR COMPANY, PHILADELPHIA, PENN.

Heat is a form of energy which, when present in large quantities, results in higher temperature. Temperature is that property which determines sensations of warmth or coolness.

A pyrometer is an instrument used for measuring temperature. Although pyrometers are applied most commonly for the measurement of higher degrees of temperature — above dull red heat — they are equally applicable to low degrees extending into the sub-zero range.

The original concept of a pyrometer was an instrument to indicate the degree of expansion caused by heating a solid body. The art of pyrometric measurement has advanced tremendously since those early days.

Manifestations of heat (Figure 1)

The increase of heat in a body produces other changes in its physical properties. Figure 1 lists some manifestations which constitute the operating principle of temperature measuring instruments in common use today. Of the seven effects of heat, numbers 1, 3, 5 and 7 provide the basic operating principle of pyrometers now in general use.

Increase in dimensions

One well known effect of heat is to increase the dimensions of a body, and this principle is still applied in many simple temperature measuring instruments. By using as a temperature measuring element two metals having widely different expansion properties, this effect can be magnified to indicate temperature and, also, to control it by actuating electric contacts.

This principle is utilized in simple expansion pyrometers and more commonly in thermostats used to control the temperature of homes. Its application is limited to lower degrees of temperature and comparatively narrow temperature spans. It has limited usage in the metals field.

Increase in pressure

Another effect of heat is to increase the pressure of a confined gas or vapor. The temperature sensitive element is filled with nitrogen gas and is connected by means of a small bore capillary tube to a pressure spiral which actuates a temperature indicator. The principle of Boyle's law is utilized and, since the nitrogen gas is confined and remains at constant volume, the gas pressure changes in direct relation with the absolute temperature of the measuring element.

The indicating scale is calibrated directly in temperature. This principle is embodied in pressure type thermometers and is applicable for temperatures up to about 800° Fahrenheit.

Emf developed due to junction of two dissimilar metals

The thermoelectric effect, produced by heating the junction of two dissimilar metals, provides the operating principle of the vast majority of pyrometers used in industry today. The measuring element is called a thermocouple and the electrical po-

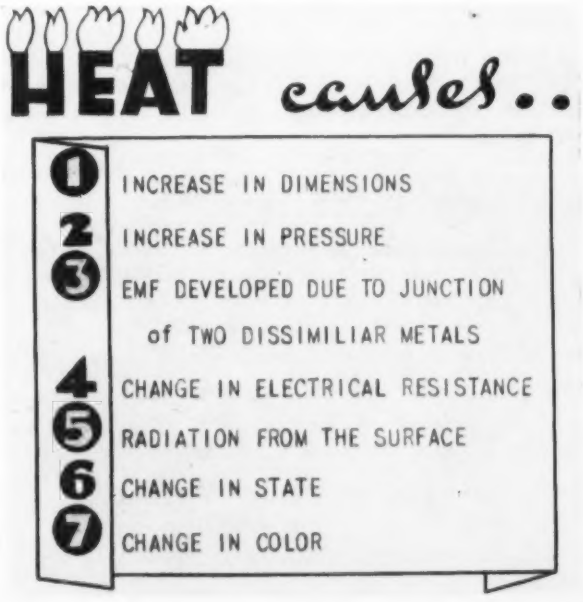

HEAT causes..
0 INCREASE IN DIMENSIONS
2 INCREASE IN PRESSURE
3 EMF DEVELOPED DUE TO JUNCTION of TWO DISSIMILIAR METALS
4 CHANGE IN ELECTRICAL RESISTANCE
5 RADIATION FROM THE SURFACE
6 CHANGE IN STATE
7 CHANGE IN COLOR

FIGURE 1 →

←FIGURE 2

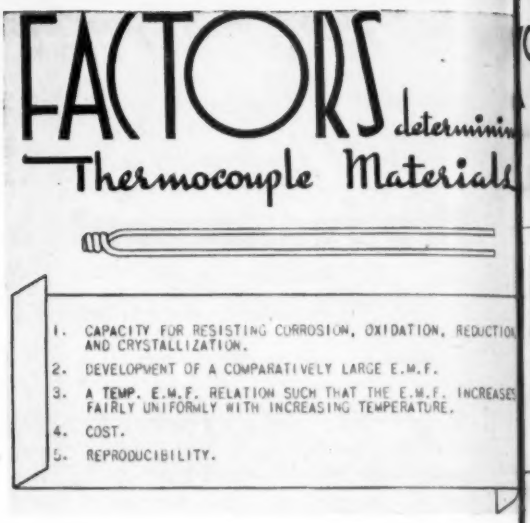

FACTORS determining
Thermocouple Materials
1. CAPACITY FOR RESISTING CORROSION, OXIDATION, REDUCTION AND CRYSTALLIZATION.
2. DEVELOPMENT OF A COMPARATIVELY LARGE E.M.F.
3. A TEMP. E.M.F. RELATION SUCH THAT THE E.M.F. INCREASES FAIRLY UNIFORMLY WITH INCREASING TEMPERATURE.
4. COST.
5. REPRODUCIBILITY.

FIGURE 3→

tential which it produces is measured by a pyrometer.

This effect will be described in greater detail later since it is of greatest significance in the study of pyrometry.

Electrical resistance

The resistance-thermometer-type instrument is commonly applied for accurately measuring temperature under 300° Fahrenheit. The measuring element is a coil of nickle wire which forms one arm of a battery-energized Wheatstone's bridge circuit. The electrical resistance of the nickel wire element varies uniformly with its temperature.

The resistance of the element is measured continuously by the Wheatstone's bridge method and it is read in terms of temperature on the indicator or recorder. This instrument has limited application in the metals field since it cannot be applied for measuring higher temperatures.

Radiation

This well known manifestation of heat, the basis of life itself, is likewise utilized for the measurement of temperature. There is a definite relationship between radiant energy emitted by a body and its absolute temperature. By concentrating these invisible radiant rays on a sensitive thermocouple we can measure temperature.

This principle offers many advantages in the metals industry and it will be discussed more fully later. It is of equal importance with the thermoelectric principle as a basic principle of pyrometry.

Change in state

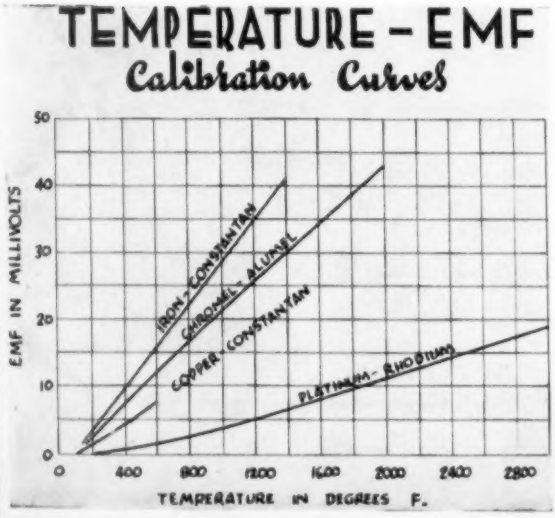
Elements and compounds will melt, liquefy or otherwise change state at certain specific degrees of temperature. This principle, used to a rather limited extent in measuring temperature, utilizes a well known device, the pyrometric cone which is still in use in the ceramic industry.

A series of cones, each having a known specific melting point, is placed in the kiln with the ware. The operator looks inside the kiln periodically to determine, approximately, the maximum temperature to which the ware has been exposed by noting which cones have sagged. This method of measurement is approximate at best and has negligible application in metal processing applications.

Change in color

The last of the heat effects with which we are concerned is change of color. There is a relation between the color of a hot object and its temperature, but the simple utilization of this principle in judging temperatures "by eye" is quite inaccurate and not dependable.

The days when we could get by with such methods have long since passed. The principle is mentioned only because it is utilized to a limited



← FIGURE 4

QUALITIES of
Protecting Tubes
1. RESISTANCE TO HIGH TEMPERATURES.
2. RESISTANCE TO ACTION OF OXIDIZING AND REDUCING GASES.
3. HIGH THERMAL CONDUCTIVITY, INSURING PROMPT TRANSMISSION OF CHANGES IN TEMPERATURE.
4. RESISTANCE TO SUDDEN CHANGES IN TEMPERATURE.
5. ABILITY TO WITHSTAND MECHANICAL SHOCKS AND STRAINS.
6. ABILITY TO WITHSTAND THE ACTION OF MOLTEN METALS.
7. RESISTANCE TO CORROSION BY ACID FUMES.

FIGURE 5 →

← FIGURE 6

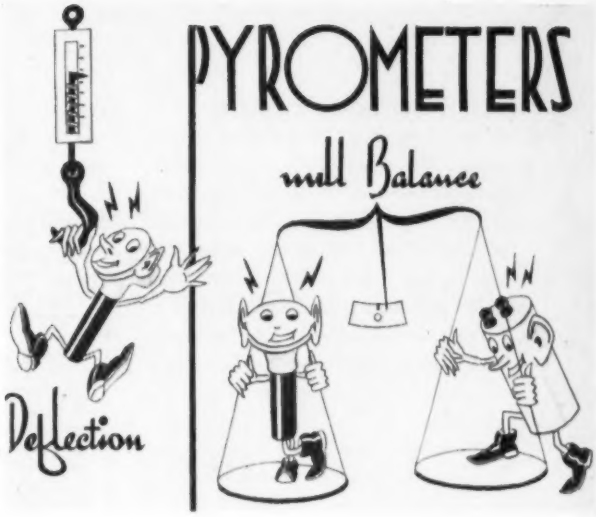


FIGURE 7 →

extent in laboratory equipment, also in some forms of "disappearing filament" optical pyrometers which reduce inaccuracies by utilizing filters to limit the portion of the spectrum transmitted to the eye. However, the human eye itself is a limiting factor in determining the accuracy of such devices.

Seebeck's discovery of thermoelectric effect (Figure 2)

In 1821 a scientist named Seebeck discovered that the junction of two dissimilar metals placed in a closed circuit would cause a small current flow when heat was applied to the junction. Further study unearthed the discovery that this current flow was caused in part by the junction of the metals and this was called the Peltier effect.

Part of the current flow was caused by the difference in temperature between the two ends of a single wire. This was called the Thompson effect. It is the combination of these effects which produces the potential measured by means of the thermoelectric pyrometer which is in most common use today.

The actual potential produced by conventional thermocouples is small and is measured by millivolts. The number of millivolts of potential produced by the thermocouple increases as the temperature of the hot junction is raised.

Factors determining thermocouple materials (Figure 3)

There are several important factors which must be considered when selecting materials for thermocouple use, namely:

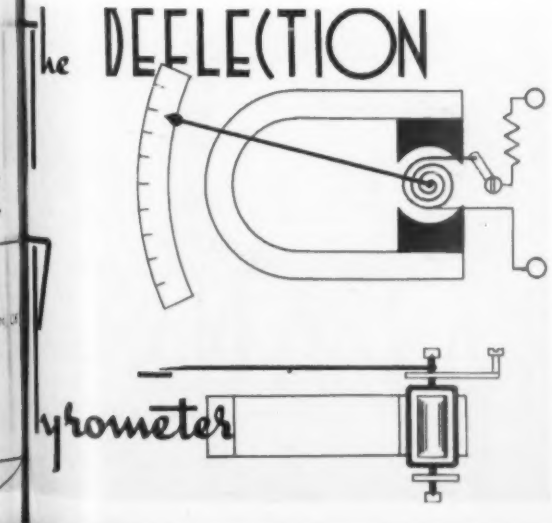
1. They must be resistant to corrosion, oxidation, reduction and crystallization.
2. They should develop a comparatively large emf.
3. They should provide a temperature emf relation so that the emf increases fairly uniformly with increasing temperature.
4. The cost should be moderate.
5. The materials should be readily reproducible.

These factors have resulted in the broad acceptance and use of the four types whose temperature emf relations are plotted in Figure 4.

Temperature-emf calibration curves (Figure 4)

This illustration shows the potential in millivolts which is produced by each of the four most commonly used thermocouples at various temperatures. Each curve is terminated at the temperature which is normally considered the practical maximum for its use.

Copper-constantan thermocouples have a pure copper wire for the positive conductor and a copper-nickle (constantan) alloy for the negative conductor. These thermocouples are usually applied for measuring de-



← FIGURE 8

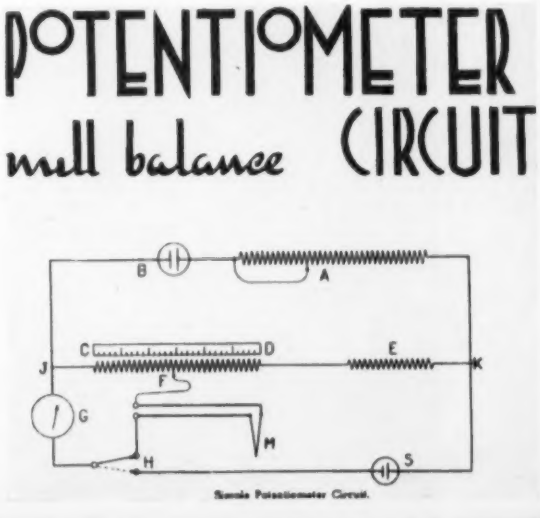


FIGURE 9 →

grees of temperature ranging from sub-zero to 600° Fahrenheit maximum. Their accuracy is reproducible commercially to within one-half degree Fahrenheit and they are low in cost. Their resistance to oxidation in moist atmosphere gives them added advantage. Their use, formerly limited to laboratory, has been extended more and more for low temperature work because of these advantages.

Iron-constantan thermocouples use iron for the positive conductor and constantan for the negative conductor. They are applied normally for degrees of temperatures up to 1440° Fahrenheit. They may be used up to 2000° Fahrenheit or higher if frequent replacement is not objectionable. They are affected by oxidation, particularly at higher temperatures, and should be used where the furnace atmospheres are of reducing nature. They are inexpensive and give satisfactory service when properly applied.

Chromel-alumel thermocouples comprise a positive conductor of nickel-chromium alloy and a negative of nickel-aluminum alloy. They may be applied in temperatures up to 2000° Fahrenheit with proper protection, provided they are not subjected to a highly reducing atmosphere condition. They are unaffected by oxidation. They have a very uniform temperature emf relation and their accuracy is readily reproducible. Their cost is somewhat higher than iron constantan but not sufficiently so to discourage their wide use.

The thermocouples described so far are all known as base metal types because they use common metals and alloys. The fourth type is commonly called a rare metal or noble metal thermocouple since it uses platinum conductors.

Editor's Note:

Instrumentation has become increasingly important in the porcelain enameling industry, as modern equipment, materials, and methods are put into use which call for accurate control of all operations. The employment of pyrometry and electronics for heat measurement is usually described in highly technical terms.

Principles involved in the measurement of heat and types of equipment used are explained and illustrated in as simple terms as possible in this 2-part article. We believe all enamelers will find this information valuable as a background for technical information on the subject.

Platinum-platinum-rhodium thermocouples are made up of a pure platinum conductor and a platinum-rhodium alloy conductor. As the curve illustrates, they may be used up to 3000° Fahrenheit, provided they are suitably protected from contaminating gases and do not have to be self-supporting. They have highest accuracy and longest life under favorable operating conditions. Because of their comparatively high cost, and the low emf produced, their application is limited largely to temperature beyond the range of chromel-alumel thermocouples.

Qualities of protecting tubes (Figure 5)

The subject of thermocouples cannot be left without some mention of the protecting tubes which are so necessary to their satisfactory performance.

In most applications it is desirable and essential to enclose the thermocouple element in a tube to protect it from deterioration and to insure reasonable length of service and accurate measurements. The selection of tubes is likewise important. Some of the factors which must be taken into account are:

1. They must be able to resist high temperatures.
2. They must resist the action of oxidizing and reducing gases.
3. High thermal conductivity is desirable to insure prompt transmission of changes in temperature.
4. They must resist thermal shock caused by rapid changes in temperature.
5. They must be able to withstand mechanical shock and strains.
6. They may have to withstand the action of molten metals.
7. They must resist corrosion by

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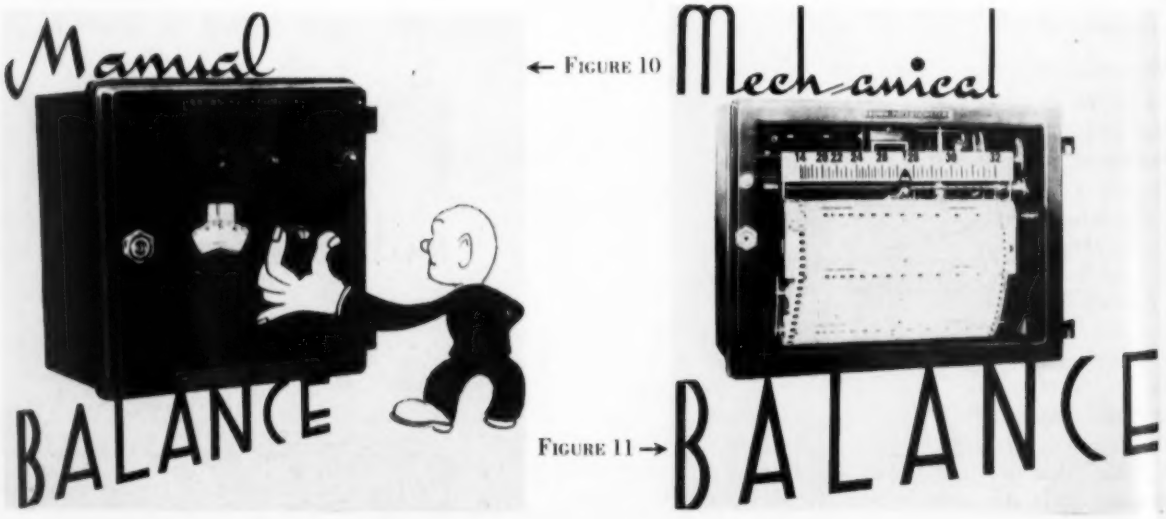

← FIGURE 10

FIGURE 11 →

American Ceramic Society

fiftieth anniversary meeting

attendance records broken at golden jubilee convention

finishfoto

Dean S. R. Scholes awards Binns Medal to Edward Winter.

CERAMIC men from all over the United States and from representative foreign countries met at the Palmer House, in Chicago, during the week of April 25 for the 50th convention of the American Ceramic Society. Official registration was reported as 1341, with total attendance exceeding 2,000. This tops the mark set by the Atlantic City convention of last year.

Whittemore installed as president

John Weed Whittemore, associate dean of engineering and head of the department of engineering at the Virginia Polytechnic Institute, succeeded John D. Sullivan to the presidency, after serving as vice president for the past year.

Educated at Iowa State College, from which he received a Bachelor of Science degree in ceramic engineering in 1921, Professor Whittemore was employed by a brick and tile company until he went to Louisiana in 1926. After two years' work for the state, while also serving as head of the department of ceramic engineering at Louisiana State University, he went to Virginia Polytechnic Institute in the same capacity in 1928. He has remained there since that time, also serving as associate dean of engineering since 1943.

H. M. Kraner, research engineer at Bethlehem Steel Company, Bethlehem, Pa., was installed as vice president; W. G. Cramer, of Industrial Ceramic Products, Inc., Columbus, Ohio, retained the post of treasurer, for the third year; and C. S. Pearce, of Columbus, now begins his fifth year as Society secretary.

General session includes educational conference

One feature of the general session held on Monday, April 26, was a ceramic educational conference at which Howard L. Bevis, president of Ohio State University, and Professor A. I. Andrews, head of the department of ceramic engineering, University of Illinois, were the featured speakers with the subjects "Ceramic Education in the United States" and "Departments of Ceramic Education and Their Work at the Present

to Page 30 →

Exhibit photos . . . Pages 28 & 29

Left to right: Enamel Division Trustee, Frank Porter; Secretary, Fred Petersen; Vice Chairman, Ben Sweo; Chairman, Dwight Moore.

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(See page 6 titled

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Mr. and Mrs. Andrew A. Yarte, Productos Ceramicos, Mexico, visit the finish *booth at the ACS exhibit hall.*

Time," respectively. This was followed by a panel discussion on ceramic education, with H. M. Kraner as moderator.

Other features on Monday's program included a presentation entitled "Fiberglas: What, Why, Where, When?," by Dr. Albert W. Davison, scientific director, Owens-Corning Fiberglas Corporation, and the Edward Orton, Jr., Fellow Lecture, "Ceramics in the Future of Housing," by Prof. William H. Scheick, head of the Small Homes Council and professor of architecture at the University of Illinois.

Full program of technical papers

There were about 130 papers on the convention program for presentation by leading technologists in, and associated with, methods, processes, materials and independent research developments. The Enamel Division was well represented with over twenty papers.

The Enamel Division sessions were held in the Crystal Room of the Palmer House, where over-capacity audiences were on hand for many of the papers.

Anniversary exhibit a success

The exhibit of equipment, supplies and services, held in conjunction with the 50th annual meeting, occupied most of the large display hall and included a good cross section of the industry.

Exhibits of prime interest to porcelain enamelers included those of the frit manufacturers, color and chemical houses, plant and laboratory equipment producers, mechanical handling devices, and the industry's technical and trade publications.

Binns medal goes to enamel artist

The Charles Fergus Binns Medal, awarded annually to the ceramic designer who has created the best piece of ceramic art during the preceding year, went to Edward Winter, of Cleveland, Ohio. Examples of Mr. Winter's work have been presented on numerous occasions in earlier issues of *finish*.

The following men were inducted as Fellows of the Society: Clarence Lloyd Babcock, George C. Betz, A. Curtis Jackson, Clarence H. Hahner, Edward Paul McNamara, Earl C. Petrie, Rolland R. Roup, Charles S. Pearce, William B. Silverman and Carl H. Zwermann.

These honors were bestowed at the Annual Banquet, held on Wednesday evening, April 28.

Other social events included the School dinners on Monday night and the Keramos dinner, the Ceramic Camera Club dinner and the Jubilee Jamboree, featuring outstanding entertainment, on Tuesday night.

On the last day of the meeting plant trips were included, for both women and men.

Cincinnati to get 51st convention

The Netherland Plaza Hotel, at Cincinnati, Ohio, will be headquarters for the 51st annual convention in 1949.

American Ceramic Society staff table includes: Robert L. Stone and Spencer L. Davis, Ohio State; Gertrude Busick, ACS; H. S. Hutchison, The Mack Printing Co.; Virginia Benedict, L. E. Ohrstedt and Helen Berger, ACS; Andre Jean Nicolin, ETS, Japy Freres; Mary Gibb, ACS.

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PHOTOS FROM THE A.C.S. BANQUET

(See page 61 for detailed captions)

finishfotos

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USS **VITRENAMEL**

UNITED STATES STEEL

Enamel division program report

A. C. S. fiftieth annual meeting

with comprehensive author's resumés of division papers

A PROGRAM of more than twenty technical papers was presented by the Enamel Division at the Golden Anniversary Meeting of the American Ceramic Society.

The program was inaugurated Tuesday morning, April 27, under the direction of Chairman J. J. Canfield, Armco Steel Corporation; Program Committee Chairman D. G. Moore; National Bureau of Standards; and Secretary F. A. Petersen, University of Illinois.

Presiding chairmen at the various sessions, which had near-capacity attendance, were: B. T. Sweely, Chicago Vitreous Enamel Product Company; J. B. Willis, Pemco Corporation; E. H. Shands, Geo. D. Roper Corporation; and W. H. Pfeiffer, Frigidaire Division, General Motors Corporation.

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The enamel division meets in the Crystal room of the Palmer House.

Election of division officers

At the Enamel Division business session, held Wednesday afternoon, April 28, election of new officers was held. Frank R. Porter, Inland Steel Company, was reelected trustee; Dwight G. Moore, Ceramics Division, National Bureau of Standards, was elected chairman; Ben J. Sweo, Ferro Enamel Corporation, was elected vice chairman; and Fred A. Petersen, Department of Ceramic Engineering, University of Illinois, was reelected secretary.

A comparison of various antimonates as opacifiers in dry-process enamels for cast-iron

By Wm. W. Coffeen

Sodium antimonate is, and has been for many years, the preferred method of introducing antimony for the opacification of dry process enamels. The effect of a number of other antimonates on enamel opacity and color were compared to determine: (1) the suitability of these compounds as substitutes for sodium antimonate, (2) the effects on the color and opacity of antimony oxide enamels to be expected if antimonates other than sodium antimonate were formed during smelting.

Antimonates of potassium, lithium, barium, calcium, magnesium, strontium, zinc, aluminum, lead and tin were substituted for sodium antimonate in an acid-resisting dry process enamel for cast iron. Variations in sodium antimonate content of this high-lead enamel were also made to permit comparisons of all antimonates to sodium antimonate, as a standard, on an equivalent antimony pentoxide basis.

A number of the above antimonates were also compared as replacements for sodium antimonate in non-acid-resisting enamels of the lead-bearing and leadless types.

Reflectance readings, made with the multipurpose reflectometer, using blue, green and amber filters, were made to indicate the opacifying ability and color characteristics of all enamels. Yellowness indices calculated from the three reflectance readings were found to correlate reasonably well with visual color estimates. Acid resistance tests were made on all acid-resisting enamels by the

standard P.E.I. method.

In acid-resisting enamels, antimonates of potassium and barium compared reasonably well with sodium antimonate in opacifying power without introducing objectionable colors. The use of barium antimonate also produced improved acid-resistance.

In non-acid resisting enamels, only barium antimonate produced results approaching sodium antimonate in both leadless and lead-bearing types.

Undesirable colors resulted from the use of all the antimonates with the exception of sodium, potassium and barium. Many of the antimonates were also found to be much less efficient as opacifiers than sodium antimonate. The chance formation during smelting of antimonates, other than the last three named, serves to explain the variations often encountered in the results obtained with antimony oxide enamels.

Residual stresses in enameled sheet iron specimens

By R. A. Jones and A. I. Andrews

Porcelain enamel coatings on metal are normally under appreciable compression at room temperature, due to the difference in the rate of expansion of enamel glasses and metals, at temperatures below the softening point of the enamel. Although thermal expansion coefficients provide a first approximation as to the magnitude of the residual stresses in an enameled specimen, many other variables such as thickness, modulus of elasticity, softening temperature, and rate of cooling must be considered in order to obtain a true picture of the existing stress conditions.

Since many properties of enameled specimens are influenced to a marked degree by the residual stress conditions present, it is important that a quantitative measure of these stresses be accurately determined. A quantitative measure of the average residual stresses in over forty ground coated, 20 gage sheet iron specimens, was obtained by measuring with a mechanical strain gage, the dimensional changes which occurred when the metal specimens were de-enameled in molten caustic soda. On removal of the enamel layers from each side of the specimen, the metal returns elastically to its unstressed state. The magnitude of this dimensional change, after being suitably corrected for temperature and de-enameling effects, is a measure of the stress system producing it. Equations were derived for calculating the enamel and metal stresses from the data obtained.

Compressive stresses of from about 13,000 psi. for enamel layers 14 mils in thickness to 38,000 psi. for layers 2 mils in thickness, were obtained. A slow cooling or annealing of the specimens was found to decrease materially the compression in the enamel layers.

The method used for quantitatively measuring the residual stresses in enameled sheet iron specimens appears accurate and practical. It is further concluded that theoretical or calculated stresses will agree closely with the measured values in slowly cooled specimens provided the correct physical constants of the enamel as it exists on the metal, are employed for making the calculations. The results obtained also indicate that as might be expected, certain properties of an enamel vary with the thickness of application. Some of the more important factors which are influenced by thickness, and which in turn influence the stress conditions or "fit" of the enamel, are thought to be bubble structure, % of dissolved iron oxide, and annealing characteristics.

The use of plastic replicas to evaluate surface texture of porcelain enamels

By Joseph C. Richmond and Allen C. Francisco

A technique for making surface replicas, developed for use on machined metal, was adapted for use on porcelain enamel.

Replicas of porcelain enamel surfaces were evaluated by haze measurements. In addition, they were examined visually, with and without magnification. Photographic prints were made directly from the replicas, by projection, without the use of a negative.

The replicas were found to reproduce accurately the surface texture of the specimens. Details that could be seen only with difficulty in the original surface were readily seen in the replicas. The replica forms a permanent record, which can be filed for future study. A series of replicas made at intervals during a test or during service enable the investigator to follow progressive breakdown of the surface.

Specimens of 25 enamels, submitted by the Porcelain Enamel Institute as representing a wide range of abrasion resistance, were given the standard (1942) P.E.I. surface abrasion test. Replicas of the abraded specimens were then rated by means of haze measurements. One representative specimen of each enamel was selected, and these 25 specimens were ranked visually in order of their apparent resistance to the abrasion treatment. The replicas from these 25 specimens were also ranked visually in the same manner.

Comparison of the ranks or ratings obtained on the 25 enamels by these various methods revealed:

(1) The ranks obtained by the loss-in-gloss method had fair statistical correlation with the ranks obtained by visual observation of the specimens, but inconsistencies on individual specimens were common.

(2) The ranks of replicas by haze measurements showed poorer statistical correlation with the ranks of the specimens obtained by visual observation than did the loss-in-gloss ratings.

(3) The ranks of replicas by visual observation correlated well with ranks of the same replicas obtained by haze measurements, but poorly

with the ranks obtained by visual observation of the specimens from which the replicas were taken.

The use of replicas eliminates the effects of the color and index of refraction of the specimens, and hence may possibly provide a better criterion of the mechanical effect of abrasion than does the appearance of the specimens themselves. It remains to be determined whether such mechanical effect is to be preferred over deterioration of appearance as a criterion of abrasion resistance.

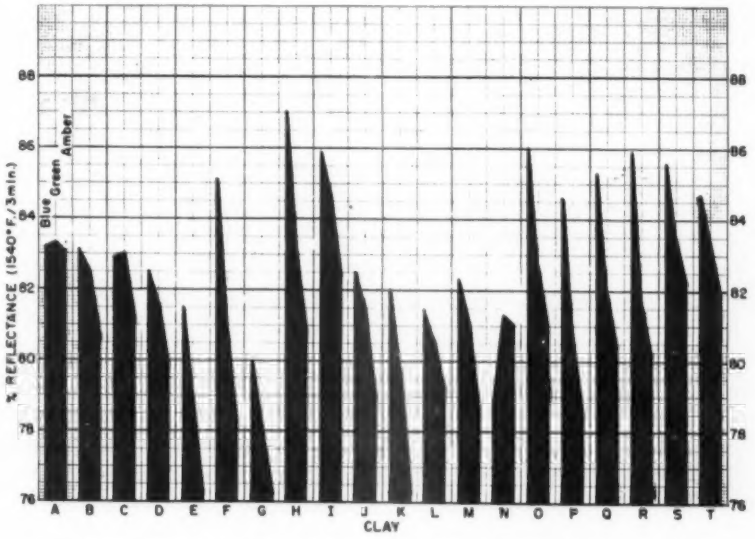
Effects of various clays used in mill additions on properties of a titania-opacified enamel

By Edward E. Marbaker, Hollis S. Saunders and Leon N. Baumer

One of the more baffling problems encountered in the development of titania-opacified enamels has been the elimination of an inherent yellowness that became more apparent as the application weight and firing temperature were increased. Considerable progress toward the solution of the problem has been accomplished by making suitable changes in the frit compositions. In the course of this development it was observed that the properties of the enamels were influenced by the clay used in the mill addition. Therefore twenty different clays were studied under carefully controlled conditions, and their effects on enamel properties evaluated.

The clays selected for this investigation mostly have long been used in commercial enameling, but a few of them are new in this application. Chemical analyses of all the clays, and X-ray spectrometric examinations of a few of them, were conducted with the idea that some correlation between clay characteristics and enamel properties might be found.

Each of the clays was milled in a one-gallon mill with a portion of a single batch of standard TiO_2-opacified frit, according to the formula: Frit 100, clay 5, potassium carbonate 1 2, and sodium nitrate 1/8 parts. Water was added in such quantity that the specific gravity of the slip was within the range 1.70-1.73. Each slip was milled to a fineness of 0.0-2.0 gms. on a 200-mesh sieve. All tests were run in duplicate, and the results, generally in close agreement, were averaged.



Graph showing the effect of clay used in mill addition on enamel reflectance and color.

The slips were sprayed on 6-in. by 4-in. and 12-in. by 2-in. 20-gage, ground-coated plates at 30 gsf. and oven-dried at 120°C. In order to evaluate the relative brushing qualities, from each 6-in. by 4-in. plate, after drying, a ¼-in. strip of the bisque was removed from the narrow end. The bisque strength was determined by testing the 12-in. by 2-in. plates in the standard cross-bending machine, afterward firing one set of plates at 1540°/3 min. and another at 1640°/3 min.

After firing one set of 6-in. by 4-in. plates at 1540°/3 min., and the other at 1640°/3 min., the reflectance and gloss were measured with a reflectometer, the color value was calculated from the reflectance values, and the acid resistance was determined by the standard method of the Porcelain Enamel Institute.

Signlficant differences such as were found among the properties of the enamels could have been caused only by the clays. Unfortunately, clays that were good in one respect were often quite poor in another. For instance, some enamels had high reflectance and poor acid resistance; and others, good color and low reflectance.

Some idea of the variation in reflectance and color pattern of the enamels caused by the clays can be obtained by study of the accompanying chart. The magnitude of the reflectance is the ordinate, and the color value can be judged by reading from left to right, the three reflectance values in the order blue, green, amber. Thus the enamel made with clay H had a very high blue reflectance, while that made with N had comparatively low reflectance and a decidedly yellow coloration. At the higher fire, the reflectance was generally higher and coloration more yellow.

Only three of the clays (A, B, N) served to produce enamels which when fired at 1540° had an acid resistance of the degree AA, while the enamels made with the others varied down to H and I, which were graded B. Firing at 1640° increased the acid resistance to AA in all cases except H, I, and R.

It was concluded from the results of the investigation that (1) the char-

acter of the clay used in the mill addition is an important factor in the determination of the properties of a titania-opacified enamel; and (2) no definite correlation was found between clay composition and performance.

Some low temperature enamel type glasses

By RETA FARNHAM AND W. G. LAWRENCE

An organized study of some known low temperature eutectics in combination with a low melting base composition discloses series of low temperature compositions.

The base low melting mixture having the composition: borax 86.3, boric acid 8.7, fluorspar 3.8, and cryolite 1.3 was combined in series with four eutectic compositions: 84% lead oxide-16% silica, 18% lithia-82% boron oxide, 26% soda-74% silica and 31.2% potash-68.8% silica in amounts varying from 0 to 100% in increments of 20%. A study of the fusion characteristics of the end member compositions and combinations as they were heated was made. Two stages were noted: the temperature of cone deformation and the temperature at which a clear homogeneous glass was developed. Observations on the various compositions were made concerning color changes during the fire, behavior on cooling and behavior on standing in the atmosphere over a period of time.

All compositions formed transparent glasses, the lowest glass forming temperatures (620°C. to 710°C.) being associated with the lead-silica eutectic plus base series. The temperature ranges for the other glasses were: soda-silica plus base- 740 to 810°C.; lithia-boron oxide series 775 to 810°C.; and potash-silica series 812 to 978°C. Fifteen compositions reaching transparency below 900°C. were determined.

Those compositions retaining transparency after several months standing in air are those of the lead-silica plus base series, the high base range of the lithia-boron oxide series, i.e. compositions having 80, 60, and 40% base, and the middle ranges of the soda-silica and the potash-silica series. Cloudiness was dominant in the end ranges of the potash-silica and soda-silica series.

Solubility tests run on representative glasses reveal the 20% base-80% lead-silica eutectic to have the highest durability of all glasses tested, a weight loss of less than one per cent after boiling in water four hours. Other solubilities in this series range up to 70% weight loss with 80% base-20% eutectic. Glasses of the lithia-boron oxide series tested are practically completely soluble and the 40% base-60% soda-silica glass has a weight loss of about 20% with the described boiling.

Some observations on reaction of enamel and iron

By G. E. MILLER AND B. J. SWEO

It has been observed and reported that the application of enamel to iron is accompanied by gas evolution. The success of direct application of enamel to iron is primarily determined by the cessation of gas evolution during the firing cycle and the complete healing over of areas through which the gases have passed. Studies of the sources of the gases evolved have been reported in the literature and have dealt chiefly with the iron and enamel individually, whereas the subject matter of this study has to do with interaction of the iron and the enamel. In view of the emphasis on application of a finish coat of enamel direct to iron, the interaction of enamel and iron and its relation to gas evolution assumes a position of timely importance.

Preliminary experimental work was conducted to determine the relative gas evolution tendencies of commercial iron and pure iron during the enameling operation. To ensure having a pure iron surface, samples of enameling iron were nickel plated by chemical reduction and iron was deposited electrolytically on the nickel coating from a solution of C. P. ferrous chloride. The nickel deposit was such that no gas evolution effects appeared when a test enamel was applied over the nickel coating indicating that the iron was effectively isolated from contact with the enamel. When the test enamel was applied over the electrolytically deposited pure iron, severe blistering resulted. An identical effect was observed when the test enamel was applied to commercial iron, indicating that the gas evolution effect manifested as blistering is primarily related to iron as such and not obviously enhanced by impurities in commercial iron.

To facilitate the observation of gas evolution effects of iron-enamel reactions, a test procedure was devised which consisted of heating a mixture of pure powdered iron and dry powdered enamel ingredients in a crucible. Under the conditions employed the evolved gases were to a great extent trapped within the fused mass resulting in an increase in volume. Determination of the apparent specific gravity of the fused mass after cooling provided a rough measure of the degree of gas evolution. By means of this test the effects of (1) time of heating, (2) temperature of heating, (3) type of frit, (4) clay content, and (5) type of electrolyte on gas evolution were determined.

In another series of tests, with the frit held constant the relative effects of various metals on gas evolution were determined. Iron, chromium, copper, nickel and manganese were the metals studied.

Moisture determinations were conducted under several conditions of heating with a test frit which had been ground dry.

It was found that when enamel ingredients and pure iron in contact

were heated to enameling temperatures the degree of gas evolution indicated by the test method described, (1) increased with increasing time of heating at a given temperature up to a maximum and remained constant thereafter, (2) increased with increasing temperature, (3) varied with the type of frit employed, (4) increased with increasing clay content, and (5) varied with the type of electrolyte addition. Tests with various metals showed that the highest gas evolution as indicated by the test method resulted with manganese, then iron, chromium, nickel and copper in that order. This order agrees with the respective positions of these metals in the electromotive series.

Moisture determinations with frit indicated that water is removed under certain conditions of heating.

Heating at 300°F. in an oven showed no loss of water. Heating at temperatures ranging from 300°F. to 750°F. in a stream of dry nitrogen effected water removal at all temperatures employed.

Discussion of results

The results of this study show that gas evolution accompanies the heating of enamel ingredients and pure iron in contact at enameling temperatures. In the course of conducting the tests it was noted in some instances that when gas evolution occurred the escaping gas burned with an incandescent flame. Inasmuch as the only constituents present in some cases were pure iron and frit containing moisture, the presence of combustible gases other than hydrogen appears improbable. The presence of water in the frit, clay and electrolytes would be conducive to the formation of hydrogen when these materials are heated in contact with iron. The reaction, $Fe + H_2O \rightleftarrows FeO + H_2$ has been discussed in the literature as applicable to iron-enamel systems.

The results with mixture of iron, frit and clay wherein gas evolution increased with increasing clay content, and therefore a corresponding increase in water content adds weight to the probability of the above reaction accounting for the gas evolution effects reported here.

Lithium in porcelain enamels

By WALTER M. FENTON

The purpose of this paper is to review the properties of new lithium compounds developed since 1945, and the effect of these compounds on enamel compositions.

In 1945, the first of the new lithium compounds was developed, namely lithium manganite. In the course of the early experiments, it was found that lithium manganite introduced as a smelter addition exhibited some very interesting properties, such as increase in fluidity and improved bond at low temperatures.

Generally speaking, it was found that by introducing from 1½ to 2% of lithium manganite into the smelter batch and eliminating manganese dioxide, and without in any other way changing the frit formula, an enamel resulted which fired 30°F. to 40°F. lower than the original enamel. As work progressed, it was found that in the kitchenware field at least, it was possible to apply the lithium enamel with a lighter application than had been the practice heretofore. A final point of particular interest to kitchen utensil manufacturers was the observed increase in resistance to thermal shock exhibited by lithium manganite ground coats when compared to non-lithium ground coats whose frit formulae were identical except for the lithium manganite.

Subsequently, a number of plants in the kitchenware field adopted lithium manganite as a mill addition on ground coats. In many cases, improvements were reported in a number of directions:

(1) Lower firing temperature and/or shorter firing time.
(2) Thinner coatings.
(3) Easier application possibly due to ability to grind finer.

The next step was the preparation of stable compounds of lithia with the oxides of aluminum, antimony, boron, cobalt, molybdenum, silicon, titanium, and zirconium, as well as with zircon.

Lithium compounds in cover coats

The use of the new lithium compounds in cover coats is more recent, and hence less information, both experimental and plant-wise, is available. For the most part, the use has been limited to titania-opacified enamels.

Lithium silicate has been in use for about a year in certain kitchenware plants as a smelter addition, and titania enamels containing 1.0% to 1.5% lithium silicate are in use. Firing temperatures, chain speeds (on continuous furnaces), vary from plant to plant, making it difficult to correlate and properly chart the effect of lithium silicate on titania-opacified enamels. Generally, lower temperatures and shorter burning time have been effected.

Since it was found that lithium silicate could not be used as a mill addition, a search was instituted for a white lithium compound which would introduce, by way of the mill, properties similar to those introduced by lithium silicate in the smelter. The first compound tested which appeared to give the necessary fluxing action was lithium titanate. An addition of as little as 0.50% had a marked effect on the fluidity of some commercial titania-opacified enamels and absence of black specking was reported. Increase in reflectance in the order of 3% to 5% has been noted over the same enamel with conventional mill additions. To date no improvement in color has been reported, that is, the use of lithium titanate does not tend to throw a neutral or creamy enamel over to the blue side. The principal results appear to be a lower or faster burning and higher reflectance on a straight line.

More recently, lithium zirconate has been substituted for the titanate in titania cover coats with marked improvement noted. Reflectance is somewhat higher, and with certain

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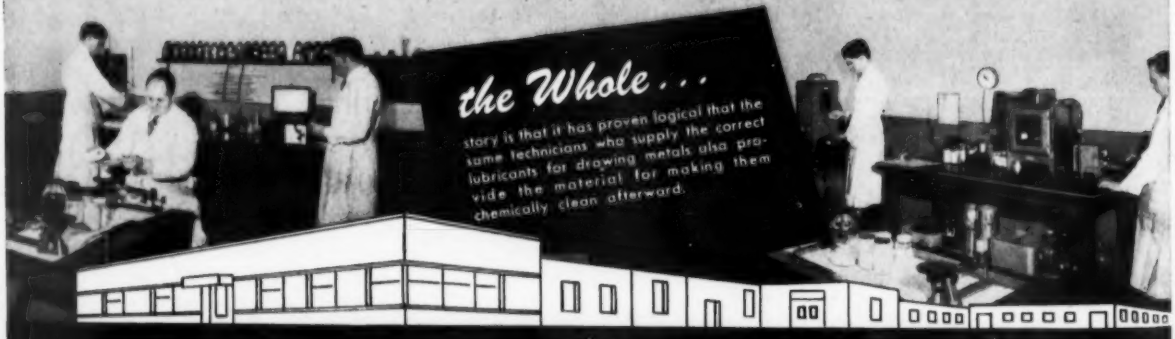

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The Washington round-up

By Wilfrid Redmond

(May 10, 1948)

REPUBLICAN leaders may have to give ground in their fight to hold the line against scarce commodity controls.

There are indications that they are preparing a strategic retreat from their position which they had hoped to hold until the November election.

First softening of this policy is contained in a report to the House Armed Services Committee by the Subcommittee on Petroleum.

Steel allocation hinted

The report, submitted by Chairman Dewey Short, of Missouri, House Republican, says:

"It is our view that if, within the next six months or less, it becomes apparent that insufficient steel can be provided to the oil industry by voluntary means to accelerate adequately its program of expansion, then *the Congress must, in the interest of national security, not temporize, not equivocate, not shirk its responsibility, unpalatable though it may be, but it must proceed forthwith to establish, by Government controls, allocations of steel to the essential users of the nation.*"

The report also indicates the line the Republican leadership will take in accepting the need for controls which the White House has been asking for since last November. *The crisis in steel will be blamed on the Administration for letting the voluntary allocations program "rock along."*

The Administration will not get a blank check on controls. The White House has so far pushed for "selective" or "standby" controls. This program, if granted, would place the whole economy under threat of regimentation.

Congress may grant authority to ration specific scarce commodities—will go no further. Steel, steel making materials, and aluminum may go under control.

Government agencies are getting policies and organization ready for controls, are competing for administration of the program. Both the National Security Resources Board and the Department of Commerce are contending for the controls program.

ECA Administrator Paul G. Hoffman says the ERP program will cause many material shortages. He has a strong "natural bias" against controls, thinks they may not be necessary as a result of ERP. But, the overall picture may be such later on that the rationing of scarce materials may be unavoidable.

The White House appears to be getting ready to go to Congress again with a strong demand for controls. Two new reasons for such authority will be given—the re-arming program and the need for building a stockpile of strategic materials.

Compromise between the White House and the Congress can be effected on the basis of these two new objectives. Previously, the Administration has asked for controls to curb inflation. Republican leaders contend we had the highest industrial production in our history in 1947—without controls. They contend controls would start production downward.

First voluntary steel allocations

The first voluntary allocation of steel in the building materials area consists of 212,000 tons for the manufacturer of warm air heating equipment, approved by a Steel Products Industry Advisory Committee.

The Committee postponed consideration of an allocation of steel for petroleum equipment. The petroleum industry has asked for 8 million tons in 1948. This is almost four times the quantity used by the industry in its peak year. Commerce will screen it down. However, the administrators of the voluntary program at Department of Commerce have this to consider—*if oil production does not go up, the nation faces rationing of petroleum products within the next six months.* It is the recommendation of the Petroleum Subcommittee of the House Armed Services Committee that if voluntary rationing does not work soon, mandatory controls be enacted.

Tin controls may continue

Authority for the continuation of tin controls is recommended in the third quarterly report of the Secretary of Commerce. The need for stockpiling, however, is placed ahead of control of end uses. The Secretary urges that a moderate degree of control over tin consumption be maintained. It is difficult to see, however, how a moderate policy can result in any accumulation for the stockpile. In order to effect a saving which would contribute 3,000 tons to the stockpile recently, the Department of Commerce tightened restrictions on the use of tinplate. Leading manufacturers of tin oxide have been before Congress this year to ask removal of controls. The present extension of tin controls expires on May 31.

Senate leaders say S. 1807, which would extend tin controls for 16 months, will be introduced before the expiration date. The bill has been reported out by the Senate Banking and Currency Committee and is ready for debate on the floor when managers of the proposal decide to bring it up. *Senator Taft is now said to be convinced that industry favors extension of tin controls.* Because he was not certain as to this he proposed and put through the three months extension which expires May 31.

The supply estimates for tin in 1948 are somewhat lower than they were in the last quarterly report. The drop is due to the scheduled delivery of 8,000 tons of tin content Bolivian concentrates to Argentina instead of the U. S. This is partially offset by the probability of larger imports of concentrates from the Netherlands East Indies than previously estimated. Arrivals in 1948 from this source may total about 12,000 tons, as compared with 5,000 tons in 1947. *All*

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Another porcelain enameled AIR MARKER

enameling plant in Nappanee, Indiana, proves perfect site for installation

By Dana Chase • EDITOR

WE had an opportunity recently to inspect what is undoubtedly the country's most unusual porcelain enameled air marker — unusual in concept and execution.

The marker is located on the roof of the Vitreous Steel Products Company plant in Nappanee, Indiana. The Vitreous Steel organization has been interested for some time in cooperating on a project that would further the use of porcelain enameled steel for air marking purposes.

An ideal site

One of the local flying students is credited with the suggestion that the Vitreous Steel plant offered an ideal site for a suitable marker. In addition to providing a broad expanse of roof surface for installing a marker, the plant immediately adjoins a straight run of track of a mainline highway (Baltimore and Ohio) and is near an equally straight run of a mainline highway (U.S. Route 6).

As is true throughout the country, the enthusiasm for the fabrication of a special marker was somewhat dampened by the critical shortage of steel. Then came the idea of using rejected table tops, and a study was made as to the possibility of meeting standard C.A.A. specifications with existing shapes and sizes. It developed that any slight variation in shape or size would be inconsequential from the air.

A drawing was then made of the proposed marker and checked with C.A.A. In the meantime, a program was put under way to save all rejected tops in sizes 25″ x 40″ and 32″ x 42″, and all leaves size 10½″ x 40″.

It took several months to accumulate the required quantity, but in the meantime all plans were completed so that when the required number of tops were finally available the predetermined plan was carried out.

First of all, the specified number of tops and leaves were sheared to the shapes required for radii and angles in the letters. All parts were then given a coat of chrome yellow acid resisting enamel to meet C.A.A. standards for color. Cement was then poured onto the backs of all tops, being held securely in place by the return flanges. This gave each top a weight factor of about 75 pounds — sufficient, when laid on a flat roof, to prevent shifting even under extreme wind conditions.

All that remained to be done was to transfer the scale drawing to the monitor type roof and lay the sections in place. One flat monitor section 30′ x 340′ provided the ideal location for the words "Nappanee, Ind.," and other adjoining roof sections were suitable in both size and location for placement of the remaining components.

One hundred and ninety-one tops, sizes 25″ x 40″, were used for the town name and state, resulting in a sign 240′ long, composed of letters 20′ high with a stroke of 25″. Twelve 25″ x 40″ tops were used for the North arrow. One hundred and twenty-three 10½″ x 40″ table leaves were used for the figures indicating longitude and latitude.

Fifty-two tops, 32″ x 42″, were used to form the South Bend arrow. This is the only part of the marker that does not conform strictly to C.A.A. specifications, but it can be clearly read from safe flying heights.

An interesting point in connection with the production of this arrow concerns the lettering. In order to avoid the necessity of cutting stencils to form the individual letters (black

on the chrome yellow background), the letters were laid out on the background, black acid resisting enamel of suitable consistency applied with an ordinary paint brush and the tops refired.

While the men at Vitreous Steel are not offering this as a practical suggestion for the development of porcelain enameled air markers, it does present a good example of how ingenuity can sometimes offset shortages or other difficulties when there is the genuine desire to accomplish an end.

Although the sign is made up of multiple components, individually placed, it is impossible from the air to see any "break" in the continuity of the letters and the result is a permanently effective marker for the safe guidance of the non-scheduled flyer.

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All that remained to be done was to transfer the scale drawing to the monitor type roof and lay the sections in place. One flat monitor section 30′ x 340′ provided the ideal location for the words "Nappanee, Ind.," and other adjoining roof sections were suitable in both size and location for placement of the remaining components.

One hundred and ninety-one tops, sizes 25″ x 40″, were used for the town name and state, resulting in a sign 240′ long, composed of letters 20′ high with a stroke of 25″. Twelve 25″ x 40″ tops were used for the North arrow. One hundred and twenty-three 10½″ x 40″ table leaves were used for the figures indicating longitude and latitude.

Fifty-two tops, 32″ x 42″, were used to form the South Bend arrow. This is the only part of the marker that does not conform strictly to C.A.A. specifications, but it can be clearly read from safe flying heights.

An interesting point in connection with the production of this arrow concerns the lettering. In order to avoid the necessity of cutting stencils to form the individual letters (black

on the chrome yellow background), the letters were laid out on the background, black acid resisting enamel of suitable consistency applied with an ordinary paint brush and the tops refired.

While the men at Vitreous Steel are not offering this as a practical suggestion for the development of porcelain enameled air markers, it does present a good example of how ingenuity can sometimes offset shortages or other difficulties when there is the genuine desire to accomplish an end.

Although the sign is made up of multiple components, individually placed, it is impossible from the air to see any "break" in the continuity of the letters and the result is a permanently effective marker for the safe guidance of the non-scheduled flyer.

→ *from Page 37*

commercial titania enamels a color change in the direction of the blue-white has been reported. Firing time has been shortened considerably while gloss is high and acid resistance is satisfactory. Work on this compound is quite new and not too widespread.

From the foregoing it is apparent that these newer compounds are extremely strong fluxes in that small and even fractional percentages have marked effects on the behavior of a variety of enamels. This use of these smaller percentages now brings lithium within the range of the economics of the enameling industry.

The effect of size and shape of titanium oxide crystals on spectrophotometric properties of titanium-bearing porcelain enamel

By A. L. Friedberg, R. B. Fischer and F. A. Petersen

Titanium-bearing enamels, although exhibiting many superior properties, have indicated an inconsistency or sensitivity of color of the fired enamel. The color seems sensitive not only to changes in the enamel composition, but also to smelting, firing, and other treatments involved in the enameling process.

An investigation was undertaken to determine the effect of the amount, size, and shape of the recrystallizing opacifying particles on the color of the fired enamel. Three different titanium enamel compositions were given varied firing treatment, and the color of the fired enamel panels was measured by the recording spectrophotometer. The size and shape of the opacifying particles were viewed in the electron microscope at 25,000X. Electron micrographs were made to record the shape and size of the particles. The relative amounts of the two allotropic forms of titanium oxide, anatase and rutile, present in the fired enamel were measured by X-ray analysis.

Electron microscope studies revealed that rutile recrystallized as stick-shaped particles and anatase appeared as irregularly-shaped, rounded particles.

Results showed that with increasing firing temperatures or firing time (a) the linear dimensions, the surface area, and the volume of single rutile and/or anatase particles increased, the rutile much more than anatase, (b) the amount of anatase crystals decreased, (c) amount of rutile crystals increased, (d) per unit volume of enamel, the number of particles, both anatase and rutile, decreased, (e) per unit volume of enamel, total surface area of opacifying particles decreased, and (f) the color as shown spectrophotometrically changed from a blue-white to cream-white.

The change in the spectrophotometric properties with different firing treatment seems to be related with the size and shape of the opacifying particles. The small particles that appear at lower firing temperatures or shorter times of firing cause a scattering of the incident light. This scattering by small particles causes a predominance of blue in the resultant apparent color. As the size of opacifying particles increased, as with longer firing time or higher firing temperature, the scattering of blue light decreased, and the absorption of light in the shorter wave length regions of the visible spectrum became more apparent. This light absorption near the shorter wave length region seems to be characteristic for the titanium enamels studied. The shape of the particles seems to be a factor in that the stick-like rutile grew bigger in size with increasing firing temperature than did anatase.

With the enamels containing both anatase and rutile crystals, a sharp change in the fired enamel color between 1500° and 1600°F. firing temperature was associated with the smaller anatase particles being the predominant opacifying material at the lower temperatures and the larger rutile crystals being predominant at higher temperatures.

Preliminary study of ceramic coatings for the high-temperature protection of molybdenum

By D. G. Moore, L. H. Bolz and W. N. Harrison

The high melting point (4750°F.) and comparatively large potential supply of molybdenum suggest that this metal may be useful at temperatures above the melting points of most metals and alloys. In order to use it at high temperatures in the presence of oxygen, however, the molybdenum must be protected against oxidation, and hence it is logical to apply a protective ceramic coating. Several such coatings were developed and applied in the form of slips to specimens of molybdenum, by dipping or spraying, after which the pieces were dried and fired at a temperature of 2150°F. in oxygen-free atmospheres. Tests on the coated pieces included (a) heating in a gas-oxygen flame, (b) heating at constant temperature in an air atmosphere, and (c) service testing of parts that were finished with a selected ceramic coating in the blast of ram-jet engines.

The results of these various tests indicated that the oxidation of the molybdenum was greatly retarded by the best of the ceramic coatings tried. In an air atmosphere at 1650°F, unprotected molybdenum sheet was found to decrease in thickness 0.02 inch in one-half hour. There was no decrease for ceramic coated molybdenum heated for 70 hours under the same conditions.

At a gas temperature approximating 3500°F., giving a surface temperature on the specimen of 2600°F. or more, only short-time protection of the molybdenum was attained. The oxidation rate at these high tem-

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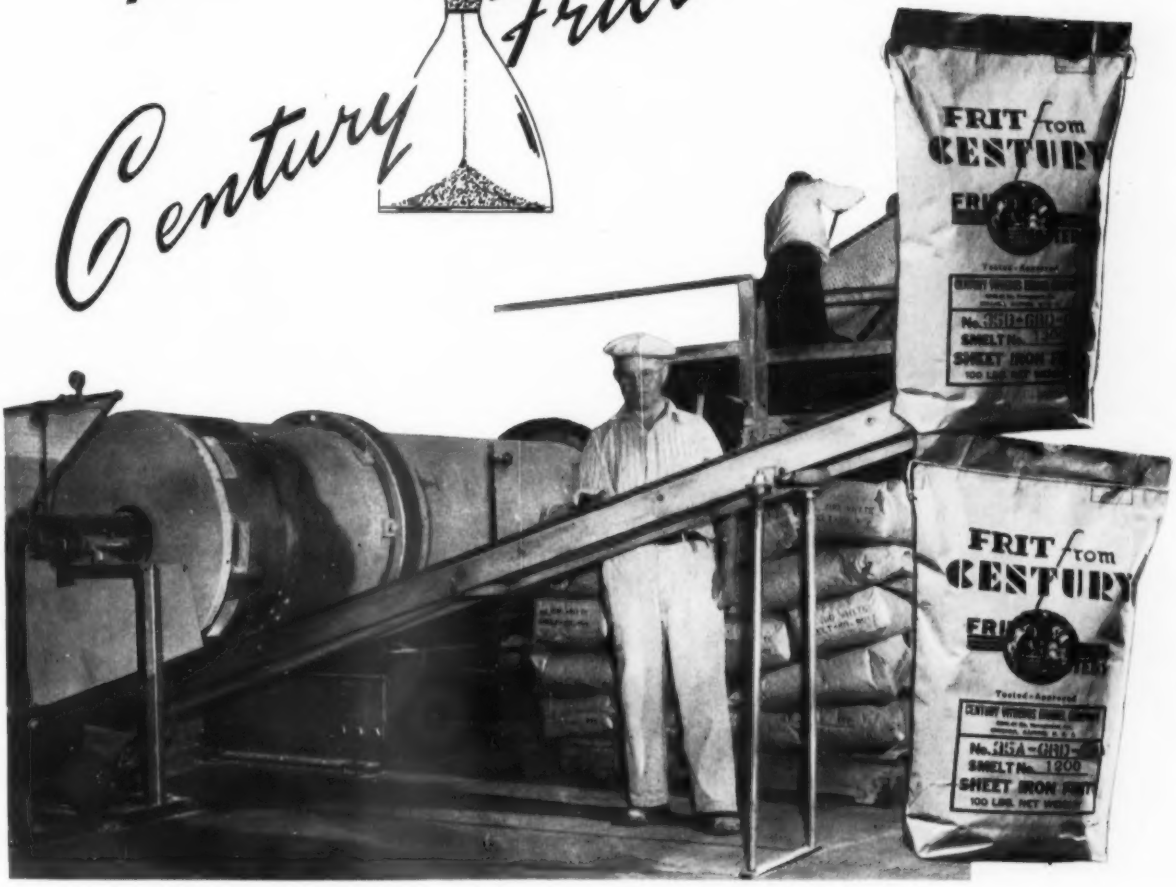

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peratures was found, however, to be sufficiently retarded by the presence of the ceramic coating to make the use of coated molybdenum feasible for special high-temperature applications in which prolonged service is not necessarily required.

One current use of these ceramic coatings is to protect molybdenum Pitot tubes which are built into the nozzle end of ram-jet engines of a type used for pilotless aircraft. These tubes, which are subjected to a gas temperature of about 3000°F., are expendable and need not last over 5 minutes. Test of a coated tube under simulated service conditions indicated a life in excess of 45 minutes.

Weather resistance of porcelain enameled steel structural units Part II

By William N. Harrison and Dwight G. Moore

During the past two decades the increased use of porcelain enamel as an architectural material, and particularly its recent application in the low cost housing field, has accentuated the need for adequate data on the weather resistance of various enamel types and for laboratory tests that will indicate weather resistance.

An investigation designed to obtain such information was begun by the Enameled Metals Section of the National Bureau of Standards in 1939. At that time a total of 864 one-foot-square panels were prepared by 16 different manufacturers together with a like number of 4- by 6-in. laboratory specimens. The panels were divided into five sets with one set kept in storage. The other four sets were installed on racks at selected exposure sites located at Washington, D. C., St. Louis, Mo., Lakeland, Fla., and Atlantic City, N. J.

The panels were installed in 1940. At the end of the first year a complete inspection was made and the data obtained from this inspection, together with preliminary work on accelerated weathering tests, was published in the Journal of Research of the National Bureau of Standards.*

Findings after 7 years exposure

The second inspection of the panels at the four locations was delayed due to war conditions and was not completed until 1947, at which time the panels had been exposed for a total of seven years. The results of this second inspection are given in the present paper. The more important findings from this inspection may be summarized as follows:

(1) No large change in the severity of weathering with location of exposure was noted at three of the four locations. The data from the St. Louis panels were not consistent with the other data due to a heavy, adherent, tar-like deposit originating from heavy smoke concentration in the test area, which was near the railway terminal. The resulting film was protective, but would not normally have been permitted to accumulate for a six-year period.

(2) Good correlation existed between acid resistance as determined by the PEI test and weather resistance as measured by the average per cent of the initial specular gloss retained. The following tabulation summarizes these data for three locations:

Acid Resistance	Weather Resistance Avg. % Gloss Retained
Class AA	74.8
Class A	67.6
Class B	61.7
Class C	50.3
Class D	42.2

(3) Noticeable fading of glossy colored enamels occurred only on those panels of poor acid resistance (class C and class D).

(4) Where enamel coverage was complete, the protection of the metal against corrosion was unimpaired after seven years for all specimens at all four locations.

*W. N. Harrison and D. G. Moore, Weather Resistance of Porcelain-Enameled Iron Structural Units, J. Research NBS, 28, 735, 1942 (RP 1476).

Effect of refractory mill additions on molten apparent viscosities of steel ground coat enamels

By B. D. Bruce and A. V. Sharon

A rotating cylinder type viscosimeter was used to determine the effect of refractory mill additions on molten apparent viscosity of steel ground coat enamels. A blend of three commercial frits was used as the base enamel to study the effect on molten viscosity of various amounts of silica, feldspar and nepheline syenite.

The apparatus consisted of a cup and spindle arrangement in which the cup containing the test material rotated about the spindle. The cup was suspended from above so that the expansion of the respective supporting elements, which were nichrome for the cup and the spindle, would act in the same direction and tend to avoid a change in depth of immersion of the spindle with changes in temperature.

The spindle assembly was supported by a piece of piano wire 0.018 inches in diameter. During a test, the wire was twisted by the torque transmitted from the revolving cup to the spindle by the test material. To measure the angle through which the spindle was rotated, a mirror with cross hair was mounted on the spindle assembly. A graduated curved scale with the radius of curvature equal to the distance from the spindle was mounted on a frame work and adjusted to the zero point with the spindle assembly at rest. When the cup assembly was rotated, the angle of rotation imparted to the spindle by the molten test material could, therefore, be measured in scale units.

The temperature of the specimen was measured with a chromel alumel thermocouple with its junction in the spindle at the center of the sample. The leads from the thermocouple emerged from the spindle support below the mirror and were in contact

with mercury baths so that continuous temperature readings could be taken with the leads having a negligible effect on the torque imparted to the spindle. The cold junction of the thermocouple was maintained at 0°C. and the E.M.F. read to ±0.01 MV.

The three commercial frits were first tested independently and then as a blend of 60% of the hard member, 20% of the medium hard, and 20% of the soft member. The refractory mill additions of silica, feldspar and nepheline syenite were tested as additions to the blend of frits.

Results indicated that silica imparted the greatest increase in molten viscosity. Additions of feldspar and nepheline syenite increased the molten viscosity about the same amount with additions of 9% or less. However, with a 12% addition of refractory, feldspar was more effective in increasing molten viscosity than was nepheline syenite.

The effect of ground coat enamel composition on the surface characteristics of cover coat enamels

By Robert W. Foraker and G. H. Spencer-Strong

The practice of firing ground coat and cover coat enamels at the same burning cycle has given rise to new problems in the industry as regards to the surface behavior of the cover coat enamels. These problems have been intensified to a considerable degree by the necessity of utilizing types of sheet metal other than enameling iron. The major function of a porcelain enamel ground coat is twofold: First, to provide bond; and second, to minimize cover coat defects due to surface eccentricities in the metal and variations in the metal cleaning treatment. The trend of industry operation towards reduction of maturing time and temperature of ground coats (which has culminated in recent years in the introduction of ground coat enamels matured together with cover coat enamels at the same burning cycle) has introduced new problems to the industry in the form of defects appearing only in the cover coat enamel, although attributable to the ground coat, and at the same time intensified some older defects.

Gas type defects due to the metal and metal surface, including pickling operations, may be increased when ground coats and cover coats are matured at the same cycle. Since the flexibility which formerly enabled the enameler to eliminate or minimize these defects through variations in ground coat mixture milling, and firing treatment, are no longer possible, greater care in pickling and the inspection of ware prior to the ground coat operation are necessary.

Although tearing is not normally considered a function of the ground coat, investigation has shown that the softer ground coats will increase the tearing tendency of cover coat enamels chiefly due to the fact that they flow into any tears which develop before the cover coat enamel can heal itself, often giving rise to black specks which appear to be quite similar visually to reboil.

Surface roughness defects, including sagging and so-called "pigskin" texture, appear to be largely a function of ground coat fluidity and stability. Investigation shows that the composition of the ground coat, its ability to withstand refire, and its resistance to the penetration of iron oxide throughout the layer, all affect its ability to perform satisfactorily. It has been found that these defects are often accentuated by conditions which would not normally be presumed to affect the ground coat at all. Thus, for example, the presence of a small amount of moisture in the firing chamber will accentuate "pigskin" texture characteristics of the cover coat even though the ground coat be fired in a moisture free atmosphere.

The effect of ground coats on the surface qualities of cover coat enamels appears to be more extensive than has been generally supposed. When ground coat enamels and cover coat enamels are matured at the same burning cycle, the effects are much greater than when ground coats are fired at a longer time and a higher temperature than the cover coats. It has been shown that the incidence of gas type defects emanating from the metal or resulting from the pickling process, sagging, extremely rough or so-called "pigskin" cover coat surface (which is increased by refire to a very considerable extent), black specking resulting from tearing, and to some extent aggravated reboiling, can be attributed to ground coat deficiencies. It is shown that the ground coat composition and reactivity with the iron is a major factor in the problem. In the solution of these problems, therefore, it is important that the ground coat and its characteristics be carefully considered even though the defects appear only in the cover coat, the ground coat in itself appearing perfectly normal.

Mottled enamel finishes by precipitation of various color producing salts

By George Sirovy and Edmund P. Czolgos

This paper is a report of colored mottle finishes, resembling marble, that were developed in sheet steel cover coat enamels by chemically precipitating through the finish incorporated mottling salts, such as cobaltous sulphate, nicklous sulphate, manganous sulphate, cupric sulphate and potassium dichromate, by means of ammonium acetate and sodium thiosulphate.

Mottling salts, in solution form, were added to the enamel slip, then precipitated out after the enamel was applied by scattering crystals of ammonium acetate and sodium thiosulphate on the wet surface of the applied enamel. Mottle designs de-

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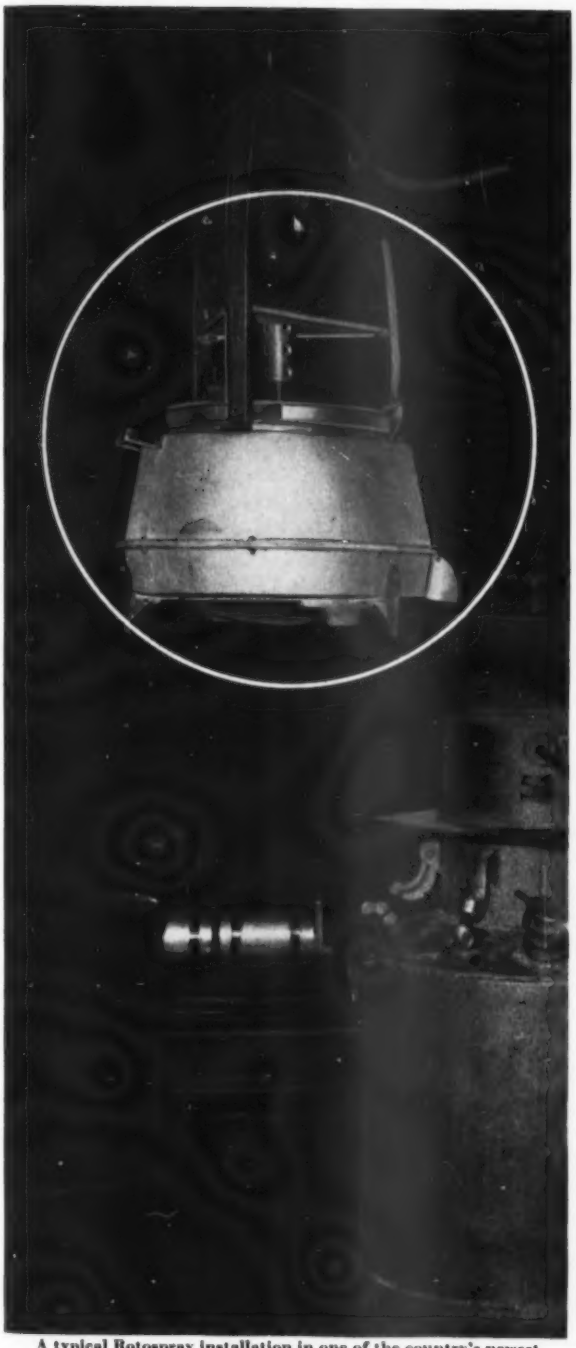

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velop as the precipitating salts dissolve in the moist enamel and react with the incorporated mottling salts. When dry, the enamel coat is fired to a luster, resulting in a smooth shiny colored, mottle finish having the appearance of marble.

The marble appearing finish consists of deep colored veins, approximately one thirty-second of an inch in thickness, entwining and enclosing irregular shaped, interjoined, shaded colored mottles having comparatively light colored centers. The size of the mottles vary up to approximately one and one-half square inches in area.

Reported mottle colors developed were yellow, green, blue, brown, red, burgundy and lavender in non-acid resisting coats, ivory, brown, red, blue and green in acid resisting finishes.

De-enameling

By G. H. SPENCER-STRONG

From a theoretical standpoint, de-enameling would appear to be a valuable process. It has attracted the attention of enamelers, and especially management, and has intrigued the minds of inventors for more than sixty years. Many articles have been written on the subject in the past, and approximately twenty patents have been issued covering de-enameling methods.

In considering the problem of de-enameling, two questions arise: First, the economic question, "Is de-enameling worthwhile?", and second, the technical question, "What are the most satisfactory methods?"

The desirability of de-enameling depends largely upon the economic factors existing at the time. Thus, in the face of metal shortages, or the presence of complicated and expensive pieces as well as special parts, de-enameling may be not only desirable, but necessary. In other cases, it may be desirable to balance the cost of the item against the value of the salvaged part and salvage cost.

Four general methods

There are four general methods of de-enameling which are in general use, three of which are chemical and one mechanical. With many types of ware, the sandblasting method would appear to be the most desirable in view of the fact that the de-enameled ware resulting from properly controlled sandblasting operations suffers from none of the defects introduced by the chemical processes and, therefore, should produce first quality ware. Aside from the equipment required, the chief handicap of this method would appear to be proper supervision of the process in order to avoid warped pieces. Insofar as the chemical methods are concerned, the molten caustic method is far more rapid than the boiling caustic solution but is probably more expensive and somewhat more hazardous. The molten caustic method cannot be used where lead bearing enamels are concerned due to the possibility of lead plating. Recent developments in this line appear to show some promise in decreased cost and longer life of bath without removal of sludge. Both the molten caustic and the boiling caustic methods require special treatment when used together with iron which has received nickel pickle, and great care must be exercised to prevent carryover of the caustic into the enameling operation.

The use of acids is not practical where acid resistant enamels are concerned, but recent improvements in the art show that by use of an inhibitor many of the previous drawbacks of the method can be eliminated, and that when used in combination with the sandblasting operation as a final cleaning, the method may be quite practical and surprisingly rapid where non-acid resisting enamels are used.

Factors affecting reproducibility of the flow button test

By W. J. PLANKENHORN

Fluidity and fusibility are two characteristics of a ground coat frit which determine its quality. Numerous laboratories check these properties in comparing enamel frits and in maintaining quality control. The test procedure varies from plant to plant, thereby eliminating the possibility of the exchange of information or data between the various members of the industry.

This study was undertaken in order to determine those conditions which must be carefully controlled to obtain reproducible results.

The effect on the flow characteristics of ground coat enamel frits, as indicated by fusion button measurements, was determined for the following factors: gauge of the test plate, location in furnace, protective enamel applied to the test plate, particle size and particle size distribution, pressures of forming and pellet dimensions, weight of pellets, temperature and timing. The effect of various binders was not investigated, as preliminary work had shown that three to five drops of distilled water produced pellets of sufficient strength for handling when pressed at 10,000 p.s.i., provided that the materials were 100 mesh or finer.

Three different cobalt-nickel bearing ground coat frits representing hard, soft and anti-copperheading types were used in the tests. Standard procedures were set up and followed in the production of the pellets, and for the firing of the fusion buttons. These procedures were adhered to throughout, except where variations were required for the several tests.

Sample plates 4″ x 8″, of 22 gauge stock, bent at a 90° angle through the center of the long dimension, were used in all tests, except where gauge was studied. The test plates were coated with a 1580° ground coat and a commercial zirconia-bearing enamel, except as noted.

Pellets were prepared from preground frit, containing a gradation of particle sizes from –60 mesh to

–325 mesh, in the shape of cylinders ½" in diameter and containing 2.5 grams of frit. All pellets were dried in a radiation dryer at 150°F., after which they were weighed and measured for height. Specimens varying more than 2% from the 2.5 grams standard were rejected.

The general test procedure consisted of placing three pellets on the horizontal leg of a coated test plate. The plate was placed in a furnace in this position for 2½ minutes, at the end of which time the plate was revolved through 90° to bring the leg of the plate supporting the pellets into a vertical position. Heating was continued for 7½ minutes, after which the plate was removed from the furnace for cooling.

The width and length of the fired buttons were measured to the nearest 1/100 inch. Both width and length varied slightly from test to test. The product of these two values was more consistent and was used in plotting the data in graph form.

Results of the various tests, presented graphically or in tabular form, showed that, (1) differences in the thickness of the metal plate had an effect upon the flow characteristics of ground coat fusion buttons, but that the differences produced were small compared to those resulting from variations in temperature, (2) the location of the plate in the furnace affected the final results due to temperature distribution, (3) pellets melted on test plates coated with cover coat enamels were in all instances smaller in both width and length than similar pellets fired on ground coated plates, (4) neither variations in particle size nor particle size distribution appreciably affected the dimensions of the resulting flow buttons, (5) pellets formed with increasing pressures of 5,000, 10,000, 15,000 and 20,000 p.s.i. produced fired buttons showing little dimensional variation, (6) the width of fired buttons containing 2.3, 2.5 and 2.7 grams of frit was reasonably consistent, but increased in length with increasing weight of material, (7) temperature differences produced the greatest variations in button dimensions (this was most noticeable with the softest material), (8) the product of the width and length of the buttons increased practically as a straight-line function of temperature, (9) with regard to firing cycle, button widths increased when the pellets remained in a vertical position for a longer portion of the total time and the length of flow decreased. The product of width multiplied by length diminished as the length of vertical flow became less.

It can be concluded that the fusion button test is a qualitative and a partially quantitative measure of the properties of fluidity and fusibility of ground coat frits. The predominant factors affecting fusion button flow are temperature and the composition of the materials being tested. The weight of the pellets and the timing or firing cycle influence the results, but to a lesser degree. Reasonable variations in particle size, fineness distribution, forming pressures, the gauge of the metal holding plate, and the coating applied to protect the plate can be tolerated without seriously affecting the dimensions of the fired buttons.

The authors' resumés of papers presented to the Enamel Division at the American Ceramic Society meeting are presented in accordance with the publication policy of the American Ceramic Society. Complete papers will be published in the Journal of the A.C.S., the A.C.S. Bulletin, or in other industry publications as released by the Society.

Space does not permit the presentation of all available resumés in this issue. Additional papers will be represented in the July issue.

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→ *from Page 39*

estimates add up to improved supply expectations in the Far East. However, the impact of the impending rearmament program should not be overlooked.

The antimony situation

It may prove necessary in the near future to develop a program for the conservation of antimony.

This would be done to assist the stockpiling effort and protect the domestic economy, the Secretary of Commerce reports.

Conservation would require the imposition of tighter use restrictions than at present. It could not be effected without the continuation of the legislative authority which expires May 31.

At present, monthly allocations are made to all applicants and inventory controls are maintained to prevent hoarding.

This is the official report:

"In view of the prospect for continuing deterioration in the supply position, however, it may be necessary to exercise more stringent controls."

Total supply of antimony in 1948 is estimated at 32,700 short tons, domestic consumption at 35,600 tons. Deterioration in the supply position is due to a drop of 3,000 tons in the flow of scrap and lower import volume than last year.

A new subsidy for the production of copper, lead, zinc, manganese, and chromite is developing in the House.

During one week recently three bills were introduced providing for such a program, all directed at producing metals for the stockpile. *The Munitions Board, which directs stockpile accumulation, has approved the objectives in this legislation.* Last year, the Munitions Board would not back the program and a premium production bill which went to the White House was vetoed. Now the Administration and the House Public Lands Committee are for such a program and Congress may act. The Administration's approval is lukewarm because the Bureau of Mines wants to leave marginal metals in the ground as a potential stockpile in event of an emergency. However, mining associations have put pressure on the Bureau which is giving lip service to support of the premium price plan. The program, calling for $100,000,000, would allow high cost marginal mine producers to operate.

The question of stockpiling

There is mounting criticism in the House of the stockpiling policies of the Munitions Board. There are insignificant quantities of some strategic metals like copper and lead in the stockpile. One industry source reported to the House Public Lands Committee recently that we only have a 5-day supply of copper in the event of war. It was also estimated from information, before the Subcommittee on Mines and Mining, of this Committee that if an emergency develops the steel industry would be producing at only 50 percent of capacity in five weeks because of deficient stocks of manganese.

There is strong support among the metal industries for a policy that would eliminate a strategic stockpile of some metals. In the event of war, these industrialists maintain that industry stocks could be accumulated for a stockpile.

Any substantial purchases of metals for the stockpile now would have to be done at above market prices and this policy would cause a ruinous inflation in the metal markets, many producers maintain. This position was supported recently in a statement by one big lead producer before the Munitions Board.

Of interest to industry is the possibility of higher prices of metal chemicals if the Munitions Board decides to start stockpiling at higher than market prices.

"Yes, sir, it's *tough* selling these days. Buyers not only expect to get merchandise but they *actually* want you to be polite!"

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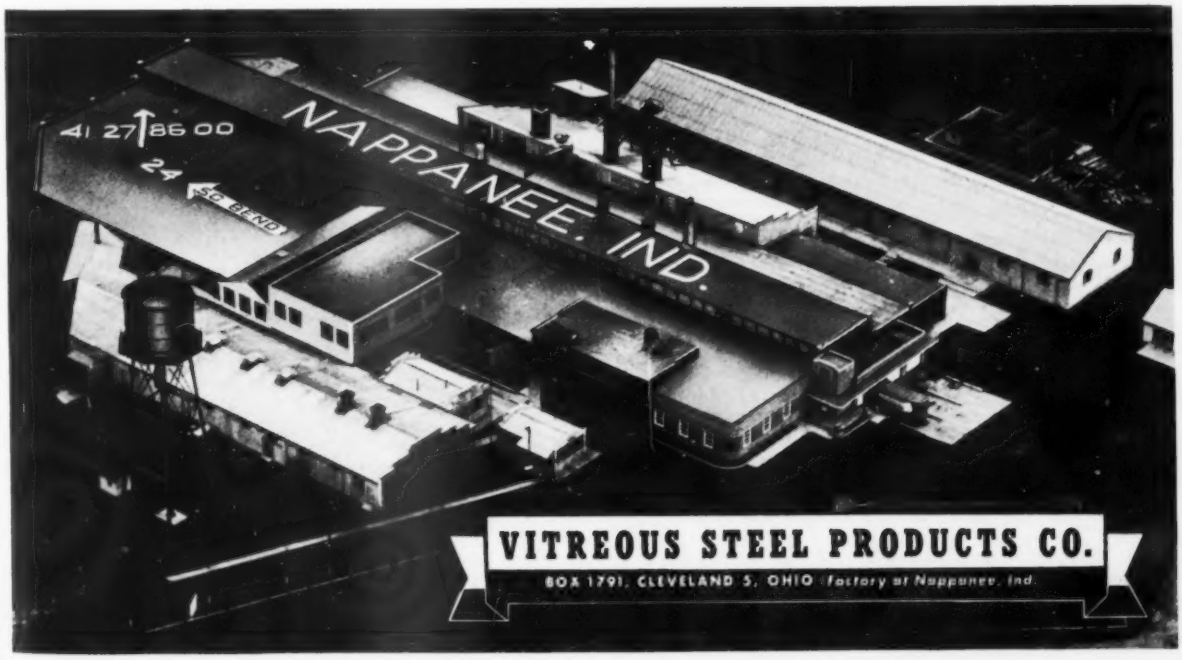
When you fly over Nappanee and see this sign, you will know that it is on the roof of the Vitreous Steel Products Co. It marks a good shop, completely equipped, in a good town, centrally located.

It is your shop if you need high quality porcelain enameled parts. Send blue print or samples. Tell us quantities, and we will quote on a complete or enameling only basis.

FOR A BETTER ENAMELLING SERVICE



APEC

American Porcelain frits have been producing first-quality porcelain enameled products for our customers since the first bag of frit was put on the market.

With increased demand for APEC frits, we have enlarged both our plant facilities and organization to offer prompt and complete service to every customer.

We are ready to serve you with frits for all types of porcelain enameled products, including the latest developments of modern enamels.

All that we ask is a chance to prove our materials in your plant. You will get prompt and friendly service, backed by years of experience in frit production and enamel plant operation.

American Porcelain Enamel Co.

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MUSKEGON, MICHIGAN

NEWS

New all-time high for washer sales

Sales of standard-size household washers went to a new all-time high in March, totalling 398,298 units, compared to the previous high of 397,113 in October, 1947, and an increase of 10.5 per cent over 360,029 for February, 1948, according to industry-wide figures announced by the American Washer and Ironer Manufacturers' Association.

Tennessee Stove executive dies

William L. McCasky, vice president of Tennessee Stove Works, Chattanooga, Tenn., died April 16.

Armco executive changes

Armco Steel Corporation has announced the election of Charles R. Hook as chairman of the board and W. W. Sebald as president of the company. It was stated that Hook, who was president since 1930, will continue as chief executive officer. Sebald formerly was executive vice president.

Florence Stove names chief engineer

Frank H. Schneider has been appointed chief engineer of Florence Stove Company's Gardner plant, it was announced by Theodore E. Keller, vice president.

For many years Schneider has served on American Gas Association's technical advisory group for domestic gas cooking research. He is also a member of the oil division technical committee of the Institute of Cooking and Heating Appliance Manufacturers.

Wade Willey to Clyde Porcelain as vice pres. & general manager

Appointment of R. Wade Willey to vice president and general manager of Clyde Porcelain Steel Corp., Clyde, Ohio, has been announced by C. C. Wells, president, who said that the new executive was elected by the board of directors at their last meeting.

For the past 10 years, Willey was assistant works manager of the Grand Rapids, Mich., plant of Nash-Kelvinator Corp. He is a graduate of Iowa State College, in 1930, with a degree in ceramic engineering and, for a short time, was with Ferro Enamel Corp., Cleveland.

Effective June 1, Willey is in complete charge of Clyde's two plants, reporting directly to the directors and the president of the firm.

Langbein leaves American Stove

It is reported that A. M. (Ollie) Langbein, for a number of years porcelain enamel superintendent at the St. Louis plant of American Stove Company, is no longer connected with the company. Information as to a new connection was not available at press date.

NESA members using porcelain enameled truck emblems

National headquarters of the National Electric Sign Association report that an increasing number of NESA porcelain enameled truck emblems are being used by members. They may be procured by contacting the executive offices.

Fleming advanced by Nashville Corp.

Charles A. Fleming has been promoted to foreman of the porcelain enamel shop of The Nashville Corporation, Nashville, Tenn., it has been reported. He previously had been foreman in charge of enamel processing.

PEI announces tentative program for 10th annual forum

The forum committee of the Porcelain Enamel Institute has announced a tentative program for the 10th annual PEI forum to be held October 13, 14 and 15 at the University of Illinois, Urbana.

The program as set up by the committee will include papers on such topics as:

Panel on Titanium Enamels, a review of their development and discussion of their general properties and application.

Panel on Application of Cover Coats Directly on Steel, discussion of special steels and their preparation for enameling; 1500° F. enamels of titanium, zirconium and other types;

1300° enamels, both one and two coat applications.

Quality Incentive Systems, including description of a system now being successfully applied in a large enameling plant.

Waste Control, the disposal of the waste products resulting from porcelain enameling operations.

Personnel Safety and Health Hazards in the porcelain enamel plant.

Budgeting Expenses in the enameling plant.

Burning Tool Equipment, their design, construction and maintenance.

Drying of porcelain enamel before firing.

Defects Occurring in Processing porcelain enamels and how to repair them for the finish line.

Cleaning of Compressed Air for spraying.

Spray Pickling Equipment, progress report on maintenance and operation.

Army and Navy Research on the use of porcelain enamel.

PEI Research, progress report of work at National Bureau of Standards.

The final session of the forum will be a "quiz" program, in which a board of experts composed of technical and processing authorities of the industry will be quizzed on porcelain enameling, according to Ed Mackasek, managing director.

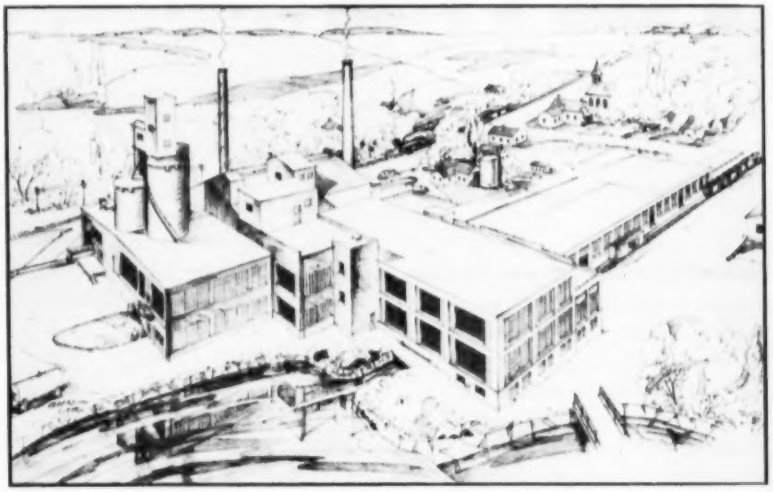
Du Pont announces $30,000,000 expansion of research facilities

A $30,000,000 expansion of research facilities at Du Pont Company's Experimental Station, Wilmington, Del., has been approved by the executive and finance committees and submitted for ratification to the board of directors, the company announced recently.

This is the biggest single laboratory project the company has ever undertaken. It will make the Wilmington Experimental Station one of the largest research establishments in the world.

"Industrial chemical research is now so complex that highly complicated equipment and specialized technical services demanding heavy investment are required for the thorough exploration of new fields," said Crawford H. Greenewalt, president of Du Pont, who added that "When the expansion is completed, the company expects to have 900 technical employees engaged exclusively in research work at the station, of which 200 will be transferred from other laboratory locations."

New Cowles Detergent plant completed



The Cowles Detergent Company, Cleveland, Ohio, has announced the completion of a new million dollar plant at Skaneateles Falls, New York. It is reported to be equipped with up-to-date technological equipment for the manufacture, packaging and shipping of heavy chemical detergent silicates as well as the company's line of specialized detergents for the commercial laundry, metal cleaning, food sanitation, and other fields.

In addition to plants at Lockport, N. Y., and Sewaren, N. J., the Skaneateles Falls plant makes it possible for the company to expand production to the point where deliveries can be effected more promptly and in increased quantities, the report states.

New porcelain enameling plant to be built in Oklahoma

Southwestern Porcelain Steels Corporation is the name of a new porcelain enameling firm to be located at Sand Springs, Oklahoma, suburb of Tulsa. Principals in the new company are James P. Wilhelm, Gordon W. Lasiter and Ellis Lasiter. Wilhelm was formerly vice president and treasurer of Moore Enameling and Manufacturing Company, West Lafayette, Ohio, and the Lasiter brothers were associated with Columbus Porcelain Metals Corp., Columbus, Ohio, Gordon Lasiter as president of the firm. It was indicated that all principals will leave their interests in Ohio plants and move their families to Tulsa.

Gordon Lasiter reports that it is expected that Southwestern Porcelain should be in operation by September. A new all-steel building, 50′ x 200′, is being erected, and the company will start operations with one box type furnace. Overhead conveyors will be utilized, and the company will specialize in sign work and general jobbing.

Principals of the new company feel they will have an untouched market in a tri-state area within easy reach of the Sand Springs location, with the closest jobbing plants in Dallas, Texas, and St. Louis, Missouri.

Dan P. Holmes, new industries chairman of the Tulsa Chamber of Commerce, is quoted in the Tulsa, Oklahoma, "World" as saying:

"We are so impressed with the importance of this industry that we are prepared to take whatever time is required to make it successful.

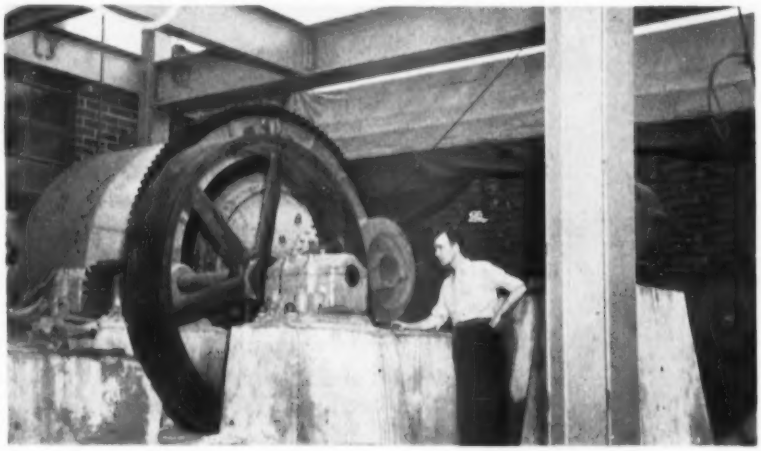
"This enameling firm will pave the way for many additional industries. We have not been in a position in the past to invite makers of such items as washing machines and refrigerators to Tulsa because we had no facilities for porcelain enameling.

"We feel that this is definitely an industry on which other industries can be established on a thriving basis."

ICHAM mid-year meeting in Cincinnati, June 7-9

The mid-year convention of The Institute of Cooking and Heating Appliance Manufacturers will be held in Cincinnati, Ohio, at the Netherland Plaza Hotel, June 7, 8 and 9.

Orefraction completing expansion program



William Bates, Orefraction engineer, checks assembly of new ball mill.

Orefraction, Inc., processors of zircon, rutile and other materials for the ceramic industry, are on the "home stretch" of a two-year expansion program which will provide an increased supply of its products, according to a report.

Only a year ago, Orefraction moved into expanded quarters in its new building on Thomas Street, Pittsburgh, and already it has been necessary to add a two-story annex to the main structure, it was stated. The ground floor of the addition will house a ball mill with air classification for milling zircon; the remainder of the floor will be devoted to other grinding and milling equipment. The second floor will be used for increasing the floor space of control and research laboratories.

These expanded operating facilities will be completed by July 1 of this year, said the report.

Ferro develops all-electric smelter

At the Nashville, Tenn., frit manufacturing plant of the Ferro Enamel Corporation, Dr. G. H. McIntyre, vice president and director of research, recently lifted the veil of secrecy from a radical development in frit smelting equipment. According to Dr. McIntyre, this new unit is the first all-electric, wholly continuous smelter in the industry and represents the outgrowth of three years' intensive research.

Operating under the direction of M. J. Bahnsen, director of chemical research, R. E. Skinner, Ferro research engineer, with the assistance of Ferro technicians, pioneered the equipment. From several small laboratory units, the design was perfected and refined until progress in early 1947 indicated that the development was advanced sufficiently to attempt trials on pilot plant scale. A smelter was completed in Ferro's Cleveland plant during the spring of 1947. Additional trials on a production scale were pursued throughout the summer, with results showing such promise that construction of a full size unit was commenced in the fall and completed about the first of this year. The Nashville plant was chosen as an erection site because of an ample and economical supply of electric current.

Commenting on the unique equipment, Engineer Skinner remarked that the outstanding features are electronic controls and wholly continuous operation.

Raw materials, accurately proportioned by automatic machinery, are fed into continuous mixing equipment and charged at a predetermined rate into the smelter. The unusual design of the unit is such that smelting time, achieved by synchronization of the rate of charging and discharging, can be adjusted to accommodate the smelting cycle of any type of porcelain enamel frit. The smelter discharges into a water filled quench pit from which the fritted enamel is removed by an automatic conveyor system and passed through a continuous dryer to the bagging machine. Electronic control of the process, handled from a single centralized station, insures, according to Skinner, absolute product uniformity. Further, he stated that production records indicate greatly reduced loss due to escaping volatiles.

When asked to comment on the types of enamels producible by the electric continuous unit, Dr. McIntyre stated that most of the present commercial formulations could be processed with excellent results. He stated that on the basis of tests conducted during the past two years, the electric smelted material showed superior uniformity. He added that new and improved enamels should result from the discovery of new smelting techniques. In a final provocative statement, Dr. McIntyre indicated that it was possible to produce enamel formulations on the electronic equipment that heretofore could not be produced on existing fuel-fired installations. Several electrically smelted compositions possessing unusual char-

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... from the BLENDS?

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Diving — and then being properly decompressed on emerging — is a mighty ticklish business. Full of hazards!

There are plenty of "hazards" — and "pains", too — when an enameling shop tries to mix its own colors and strive for a perfect match.

That's a job for specialists — O. Hommel Company, the leading example.

Here's why it will pay you to buy ready-mixed colors from Hommel:

(1) Speed up your production;
(2) Avoid expensive experiments;
(3) Get the right match every time, on time;
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Don't waste valuable production time and money "rolling your own".

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Our Technical Staff and Samples are available to you without obligation. Let us help you with your problems.

World's Most Complete Ceramic Supplier

acteristics are now undergoing extensive tests in company laboratories.

C. D. Clawson, Ferro president, stated that the electric continuous smelter at Nashville has passed beyond the development stage and has been transferred to the production department. The unit is producing standard, superopaque, cover coat frits, but at present electrically smelted frits constitute only a minor percentage of Ferro production. Statements by company officials indicate that an eventual changeover of all existing smelter equipment to the new electric continuous type is contemplated for the long range. Production of electrically smelted frit should rise sharply in the near future, Clawson said, with construction under way for another unit in Nashville and one in the Cleveland plant.

New Gary sheet mill in operation

A new four-stand tandem rolling mill went into operation April 28 at the Gary Sheet and Tin Mill of Carnegie-Illinois Steel Corporation, subsidiary of United States Steel, it was announced by Charles A. Ferguson, general superintendent.

Incorporating the latest improvements, the 54-inch mill is said to be capable of rolling coils up to 48 inches in width and is adaptable for both sheet and tin plate products.

U. of I. radio station broadcasts series on ceramics

The story of ceramics is being told in a series of non-commercial educational broadcasts over WILL, University of Illinois radio station, every Tuesday at 4:15 p.m. The 26-week series started April 6.

Hotpoint pushes neon sign program

Hotpoint, Inc., Chicago, has launched a new dealer store identification and product display program through its distributors. The program is aimed at a "neon sign for every dealer" and a display background for every product.

Distributors have been informed by Hollis C. Doss, sales planning manager, that their goal should be "sign dominance in each city and on each Main Street that reflects the leadership and top position in his community that Hotpoint products give to dealers."

International congress in London

The Institute of Vitreous Enamelers of Great Britain will hold an International Congress on Porcelain Enameling in London, England, September 28, 29 and 30, it has been announced.

A tentative Congress program includes a paper "Molybdenum in Enamel" by Karl Kautz, Climax Molybdenum Company. Plans are also being made to arrange a tour of various enameling works in England for overseas visitors.

Porcelain Enamel Institute membership campaign gains momentum

Thirteen new member companies have been added to the Porcelain Enamel Institute since the beginning of the Institute's 1948 membership campaign, according to John Tuthill, The Youngstown Sheet and Tube Company, chairman of the current PEI membership drive, and Dana Chase, editor of *finish*, co-chairman of the drive.

The list of new members released by the membership committee:

AllianceWare, Inc., Alliance, Ohio

Architectural Porcelain Constructors, Oakland, California

Briggs Manufacturing Company, Detroit, Michigan

Caloric Stove Corporation, Topton, Pennsylvania

Davidson Enamel Products, Inc., Lima, Ohio

General Porcelain Enameling and Mfg. Co., Chicago, Illinois

Hopes Body Works, Div. of Charles Hope Limited, Brisbane, Australia

Mullins Manufacturing Corporation, Salem & Warren, Ohio

Newark Stove Company, Newark, Ohio

Porcelain Engineering Company, Chicago, Illinois

Promat Division, Poor & Company, Waukegan, Illinois

Smoot-Holman Company, Inglewood, California

Strong Manufacturing Company, Sebring, Ohio

Companies interested in discussing membership in the Porcelain Enamel Institute are urged by Mr. Tuthill and Mr. Chase to write PEI headquarters, Washington, D. C., for full information. Personal contacts will then be arranged on request at the convenience of the interested company.

In commenting on the early results of the membership drive, C. D. Clawson, Institute president, said, "Our prime purpose for 1948 will be to expand the Institute benefits and the number of companies to which they accrue by carrying out an effective membership campaign to welcome those companies who have not formerly been included in our membership classification but who have an important stake in the industry as a result of large investments in plant equipment and organization personnel.

"We have every reason to be pleased with the cordial reception accorded our membership representatives," President Clawson further commented, "and we are confident, on the basis of early results, that the drive will be an outstanding success. Full benefit of the Institute cannot be realized until *all* of the leading producers of porcelain enameled products are represented on the Porcelain Enamel Institute roster."

Pemco announces three promotions

W. R. Greer, vice president of Pemco Corporation, Baltimore, Md., has announced that Harry Ingersoll has been promoted to manager of Pacific Coast Sales. In his new capacity, Ingersoll will direct the sales and service efforts of Pemco's West Coast organization and manage the company's West Coast warehouse. He has been connected with Pemco for 12 years in the capacity of sales and service engineer for the West Coast territory. Before joining the organization, he was associated with Frigidaire Division of General Motors Corporation.

Simultaneously, H. G. Wolfram, vice president in charge of manufacturing of the Baltimore company, announced the appointment of Henry E. Craven to manager of materials and processes, and Sidney F. Taylor to superintendent of production.

Craven, a ceramic engineer graduate from North Carolina State College, joined the company in 1933. Taylor, in his new position will have complete charge of all production for the Pemco plant.

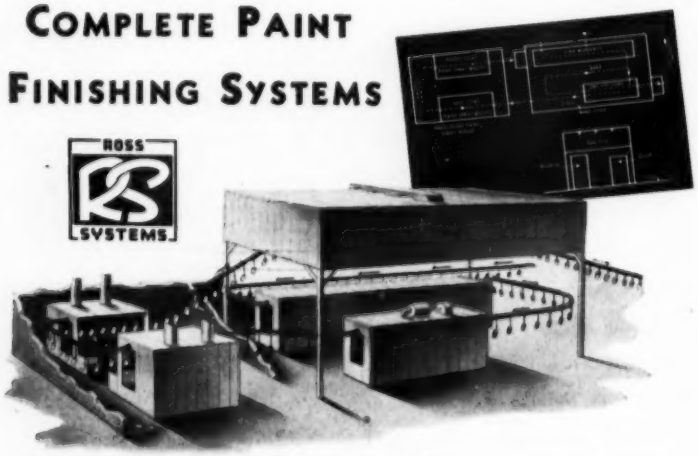
PMI elects new officers

At the annual meeting of the trustees of the Pressed Metal Institute, held in Cleveland, Ohio, April 21, the following officers were elected:

President, Tom J. Smith, Jr.; Executive Vice President, Walter A. Gorrell; and Secretary-Treasurer, J. J. Boehm.

COMPLETE PAINT FINISHING SYSTEMS

ROSS RS SYSTEMS



complete coordination of all component parts
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CONVEYOR
Types available — overhead monorail, floor type pusher, cross bars on two chains, mesh or apron conveyor, power and free rail.

LOADING & UNLOADING
Manual or automatic; space requirements, to be determined by material flow.

METAL CLEANING
Degreasing by vapor process; washing by spray or immersion; selection depends on oils or drawing compounds on metal.

RUST PROOFING
Application of rust inhibiting coat for certain articles.

BLOW-OFF
Manual or automatic — to remove large surface drops or entrained water — depends on suspension and drainage.

DRY-OFF
Heated oven to remove all remaining moisture.

COOLING
Natural or forced, to cool metal to below 100° F before painting.

PAINTING
Applied by spray, dip, flow-coat or electrostatic methods; manual or automatic.

FLASH TIME
To slowly remove solvents when desired before baking.

PAINT BAKE OVEN
Heat up time built in. The correct baking curves with minimum temperature variation. Balanced air distribution.

PROCESSING
Rubbing, sanding, inspection and touch up where needed.

FINAL COOLING
To harden finish and permit handling.

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Seeger employee among Twin City's best bowlers

Ed Schink, experimental department, Seeger Refrigerator Co., St. Paul, Minn., is city-wide famous for his bowling technique. Schink bowled approximately twenty series of 600 scores in 1947. His highest single game was 289. At the time he was chosen for the Twin City Match, he bowled an average of 200 pins a game.

Runyan is Lustron chief engineer

Robert Runyan is chief engineer for Lustron Corporation, manufacturers of porcelain enamel all-steel homes, Carl G. Strandlund, president, announces.

Runyan was associated with Strandlund at Oliver Farm Equipment Co., and was with Chicago Vitreous in 1942 while Strandlund was vice president and general manager. Chi-

to Page 66 →

Who's Who in the ACS exhibits

(Captions — Pages 28 & 29)

Top row: **METALLOY**—W. W. Osborne, Metalloy; P. S. Montemayor, Jr., Troqueles Y Esmaltes, S.A., Monterrey; Jeanne M. Griep, Metalloy; Harry Sigwart, Seneca Glass Co.; Walter M. Fenton, Metalloy. **ROBBINS & MYERS**—J. S. Nordyke, Eagle-Picher; John C. Nevins, Bausch & Lomb; K. F. Gladden, F. C. Byram, and O. W. Crabbs, all of Robbins & Myers. **O. HOMMEL**—K. E. Weber, O. Hommel; Mrs. E. P. Wright, Homer Laughlin China Co.; W. E. Dougherty, O. Hommel; George J. Middleton, Gladding, McBean & Co.; Chandubhai G. Aman, Missouri School of Mines. **CERAMIC COLOR**—Robert W. Pelz, Ferro; Burgess M. Hurd and W. F. Wenning, Ceramic Color; W. J. Sutton, N.Y. State College of Ceramics.

Second row: **DE VILBISS**—Melvin Schwenn and L. A. Stohl, Wisconsin Porcelain; Marcel L. Pouilly, DeVilbiss; Ruben Sand, Ceramic Arts Studio. **ROTOSPRAY**—Mrs. Vera Smith; Paul L. Redlich, Rotospray; W. D. Nicol, Chicago Vit.; Wm. Lindsay, Rotospray. **FERRO**—Charles B. Williams, Ferro; B. L. Mornin, Missouri School of Mines; C. C. Cooke and D. P. Hall, Owens-Illinois Glass Co. **FINISH**—M. G. Yutzey, Fostoria Glass Co.; Ben Oman; Robert S. Degenkolb, U. of I.; Genevieve Kehl, *finish*; Levant Huyck, Huyck Construction; F. B. Maloney, Hauck Mfg. Co.

Third row: **BROWN INSTRUMENT**—R. M. Woodside and John R. Green, Brown Instrument; John Isenhour, Isenhour Brick & Tile. **PEMCO**—Howard Williams, Pemco; Earl E. Baldauf and R. Y. Lennis, National Tile & Mfg. Co. **FRANTZ FERROFILTER**—Roy Trautman, Chicago Vit.; S. G. Frantz, S. G. Frantz Co.; Bill Adams, Chicago Vit. **AMERICAN NEPHELINE**—Dave Kravitz, Regal China Co.; C. J. Koenig, Ohio State; Harold Deeth, American Nepheline Corp.; Frank P. Sabel, National Gypsum.

Fourth row: **TITANIUM ALLOY**—Harold D. Prior, TAM; Bill Bates, Orefraction; Ken Strong and Karl Thews, TAM; Andrew A. Yarte, Productos Ceramicos. **OREFRACTION**—Bill Bates, Orefraction; Sam Zerfoss, Naval Research; A. K. Kreuer and John W. Lennon, Orefraction; Earl C. Petrie, North American Refractories; Jack Hunt, Orefraction; R. J. Bjorkman, Chicago Vit. **B. F. DRAKENFELD**—J. Gordon Stewart, Braun Corp.; Frank Jansma, Drakenfeld; A. F. Horn (standing), Corning Glass Works; V. H. Remington and Irwin F. Zeiller, Drakenfeld; Andrew A. Yarte, Productos Ceramicos, S.A. **BINKS**—Mrs. Roger Johnston; E. G. Hember, Eriez; B. J. Hedger and C. J. Rood, Binks; G. R. Wellman, Eriez.

Who's Who at the Banquet

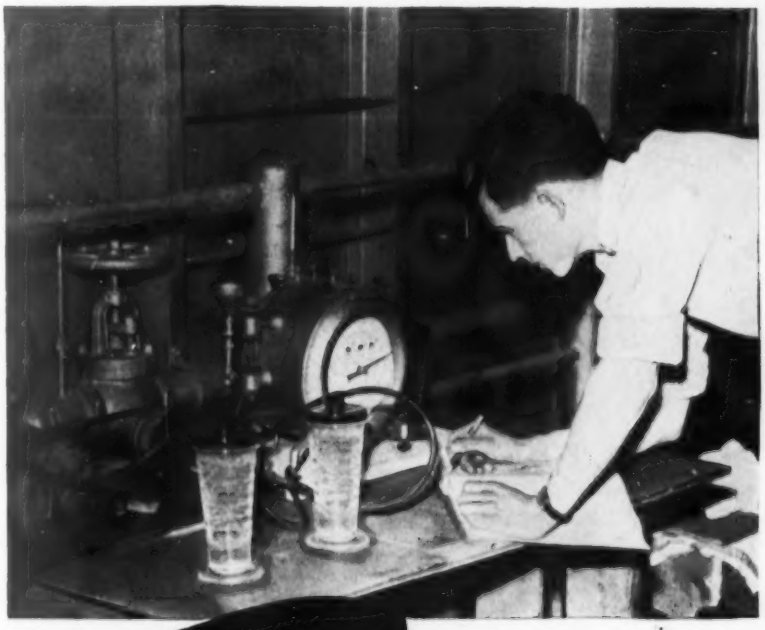
(Captions — Page 31)

Top row—Left: Mr. and Mrs. Everett Shands, Geo. D. Roper Corp. Right: Mrs. Keith Bliss and Dr. G. H. Spencer-Strong, Pemco.

Second row—Left: Mrs. Roberto Sada, Jr., Mr. and Mrs. August Lindberg, and Mr. and Mrs. Miguel Garza, Vidriera Monterrey S.A. Right: Mr. and Mrs. Rodolfo Garcia, Vidro Plano S.A.; Raul Gonzalez, Vidrieria Los Reges; Tito Strozzi, Troqueles Y Esmaltes S.A.; Roberto Sada, Jr., Keramos S.A.

Third row—Left: Mrs. P. M. Corbett, and Mr. and Mrs. Wilfred Astles, Union Oxide & Chemical Company. Right: Mrs. R. S. Olson; Mr. and Mrs. Herbert Turk, Mr. and Mrs. James Willis, and Mr. and Mrs. H. G. Wolfram, all of Pemco; Mr. and Mrs. Wm. R. Malkin, Drakenfeld; and R. S. Olson, Armour Research Foundation.

Bottom row—Left: Mrs. and Mr. J. P. Schloffman, Tennessee Enamel; Mrs. and Mr. Levant Huyck, Huyck Construction; Mrs. Ferd Rozene; Mrs. G. W. Hofstetter; Ferd Rozene, American Stove; Mrs. Lee Donley, Ferro. Right: Mr. and Mrs. Ed Bolin and Mr. and Mrs. E. P. Walters, Chicago Vit.; D. G. Bennett, U. of I.; R. C. Boyd and Robert J. Ulrich, American Radiator & Std. Sanitary; Mr. and Mrs. Wayne Duvall, Chicago Vit.



PICTURE OF PORCELAIN ENAMEL *Scumming* BEING ELIMINATED

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This, and more, is available through Ferro's ANALYTICAL CHECK-UP SERVICE—a service that has brought new economies to Porcelain enameling. Ask your Ferro Representative to tell you about it. Or write direct for further details.

"Bakes Pure White Enamel Uniformly"

Says Toledo Scale Company

Complete Finishing Systems

Continuous conveyor oven for baking finishes on oil burner parts.

Overhead monorail conveyorized system for finishing home freezer cabinets.

Now Adds New Mechanized Rustproofing System

Without discolorations or other defects, the Toledo Scale Co. has baked white enamel finishes with efficient and economical, direct gas fired Despatch heaters for three years. As manufacturers of precision scales and food processing equipment, they have expressed complete satisfaction with their Despatch 3-section oven.

Recently, Toledo Scale added a mechanized Despatch rustproofing system which has further speeded production, reduced man hours, cut costs and boosted quality and uniformity.

Such success is typical of the 50,000 heat processing installations designed and built by Despatch over the last 46 years. Despatch engineers are ready to serve you in all principal cities.

Write today for finish baking bulletin No. 51

DESPATCH OVEN COMPANY

Minneapolis Office: 619 S. E. 6th Street

Chicago Office: 511 N. LaSalle Street

Offices in All Principal Cities

DESPATCH
OVEN COMPANY

The world's largest enameling plant takes shape

a report on progress by Lustron Corporation

finishfoto

The flashing Lustron sign, lustrous by day and brilliant by night, is in proportion to the overall plant size. It is 69′ long, has a letter "L" 25′ high, and the letters "USTRON" are 6′ in height.

A VISIT to the new Lustron Corporation plant, which is now taking shape in the former Curtiss-Wright plant near the Municipal Airport at Columbus, Ohio, proved an eye-opener despite earlier reports that the plant would be the world's largest when completed.

In mid-April, we found eleven continuous furnaces in various stages of completion, at least two of them unquestionably the largest ever built. These two electric furnaces will have 11′-2″ side walls. Six other furnaces, designed for gas or oil, are 180′ in length; two more are 150′ long; and No. 11, the "smallest" of the lot, a conventional 120′ furnace.

To go with this furnace lineup, there will be approximately 22 gas-fired dryers, several of which were installed at the time of the visit. Mills and other equipment are in proportion. We saw eight ball mills of 7500 lb. capacity.

By the time this news article goes to press, it is expected that the first units of this breath-taking plant will be nearing completion.

To stand on a balcony at second floor office level, and overlook the main room of this plant which is 340′ wide by 1400′ long, with a ceiling height of 47′, it's hard to form any conception of the potential production possibilities of so giant a plant. The main building just referred to also has a balcony 100′ x 1400′, and in addition there is a second building 250′ x 1000′. Here Lustron expects to turn out 100 complete homes per day, each home using approximately 7,000 square feet of porcelain enameled metal.

New York City was getting its first look at the Lustron Home while we toured the plant in Columbus. Following a press conference, held by Carl Strandlund, Lustron president, at the Hotel Biltmore on Tuesday, April 13, the Lustron Home was unveiled in a preview for New York State and City, Connecticut and New Jersey government officials, housing heads, labor, veteran representatives and other interested dignitaries.

The Lustron model home, located at 52nd Street and the Avenue of the Americas, in New York City, was furnished and decorated under the direction of Mary Davies Gillies, *McCall's* magazine. *(Females Are the Practical Sex — January, 1944, finish.)*

Following on the heels of the New York showing, it is expected that nationwide publicity will be given the home through such mediums as

This air view of the Lustron plant, at Columbus, Ohio, gives some conception of its size through comparison with cars in the parking lot to the left.

R. G. Davis, executive vice president; Carl Strandlund, president, and Ernest Olsen, plant manager, talk things over in the fabricating department of the new Lustron plant as presses are installed.

McCall's, Mademoiselle, Business Week, Life, Fortune, and the nation's leading newspapers. Lustron reports the following from among comments by leading lights: *Emily Post* — "Intelligent planning has gone into this home"; *Norman Brokenshire* — " . . . the greatest single development in housing since they first put one stone on top of another"; *New York Times* — "The two-bedroom home is made on the principle of 'a place for everything and everything in its place' . . .; *New York Herald Tribune* — "Women who find themselves keeping house in a Lustron Home shouldn't have too hard a time of it . . . " "Lustron is the first fully industrialized house, where there is likelihood that progressive cost reduction can be achieved."

Just three weeks after the unveiling of the home in New York, 68,300 people had visited the home. *(Admission is twenty-five cents, resulting funds being donated to charity.)*

Following a first double-page spread ad in Life magazine, released simultaneously with large space in leading newspapers throughout the country carrying a progress report on Lustron, the sales promotion department reported receipt of more than 150,000 letters from the public by the end of the first week.

Society of Illustrators gave the Lustron Home another shot at limelight by offering a Lustron Home as the grand prize at the Artists' and Models' Ball. Such well-known artists as Norman Rockwell, Steven Dohanos, James Montgomery Flagg and many others are said to have toured the countryside discussing the home and selling tickets for the drawing, over 100,000 of which were purchased. At midnight, April 30, before 3,000 people in attendance at the dance, Mr. Strandlund participated in the ceremony surrounding the drawing of the grand prize, which was won by Mrs. Michael Toosusian, of New York City.

As of today, May 11, Carl Strandlund announced that the company has placed the largest single order for frit and clay . . . . $1,206,445.50 order placed with the Chicago Vitreous Enamel Product Co. The order called for 10,578,000 pounds of material.

finishfoto

Don Armstrong, assistant to the manager of the ceramic division, stands by one of the large ball mills which is ready for installation in the porcelain enameling division. This mill has a capacity of 7500 pounds.

2 WAYS
TO APPROACH A COLOR PROBLEM

CHAIN YOURSELF TO YOUR DESK OR ASK DRAKENFELD TO HELP

WHY shackle yourself with a porcelain enamel color problem when there is so little time, so many other things to do. Why do it when Drakenfeld's many years of experience and highly specialized skill may find the answer for you?

Whether your problem involves the formulation of new porcelain enamel colors or the matching of old, Drakenfeld takes every precaution to assure you top quality, uniformity and the satisfaction of every other requirement to "fit" your frits and production methods. So—let us apply our broad experience and research facilities to help you attain greater production, fewer rejects and better, more profitable porcelain enamel products.

Learn all about our dependable service, whatever your porcelain enamel color need or problem. Give us your requirements. Write today.

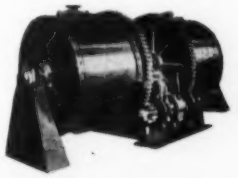
DEPENDABLE SERVICE ON: Oxide Colors . . . Screening Paste . . . Graining Colors . . . Squeegee Oils and Mediums . . . Rotospray Sifters . . . Steveco Grinding Mills . . . Porcelain Grinding Balls . . . Porcelain Mill Linings.

Rotospray — a millroom must!

The Rotospray helps you get properly prepared slip for the production line. Indispensable for "reconditioning" enamel slip. Equally valuable at ground coat dip tanks. Ideal for any job that requires speedy, positive sieving. Strains through a long-life vertical screen — no clogging. Standard and Junior sizes. Capacities range from 300 to 1,000 G.P.H., depending on nature and specific gravity of product, screen mesh and sifter size. Write for descriptive folder.

5 SAVINGS WITH STEVECO MILLS

Time
Labor
Horsepower
Floor Space
Initial Costs



Steveco high-efficiency duplex mills wet-grind porcelain enamel materials faster, better and at low cost. Many outstanding construction features proved in hard day-after-day service in many plants. Wide range of sizes and linings, with all types of drives. Write for catalog, then let us study your grinding needs and recommend the correct type for your requirements.

Drakenfeld

YOUR PARTNER IN SOLVING COLOR PROBLEMS

B. F. DRAKENFELD & Co., Inc. 45-47 Park Place, New York 7, N. Y.

Factory and Laboratories: Washington, Pa.

Pacific Coast Agents: Braun Corp., Los Angeles 21 . . . Braun-Knecht-Heimann Co., San Francisco 19

→ *from Page 60*

cago Vit produced the first Lustron home which was erected nearly two years ago in Hinsdale, Ill. Lustron reports that this pilot home was the result of development and engineering at a cost of $1,500,000.

Lansdale Porcelain advances Albright

Announcement comes from Robert L. Krupp, president of Lansdale Porcelain Enamel Corporation, Lansdale, Pa., that Grover C. Albright, Jr., is now treasurer and a director of the company.

Ovens get trial by fire

A fire in a large midwestern processing plant recently subjected four industrial drying ovens to an unusual test of design and construction.

The fire generated such intense heat that 8″ H-columns were actually twisted into the shape of a letter S causing the concrete floor at these points to sag approximately 16″. As a result, three of the drying ovens were canted toward each other and pitched at one corner about 16″ downward in a 20 ft. span.

When the fire was extinguished, it was found that the ovens, built and installed by J. O. Ross Engineering Corp., remained intact. The report states that the oven floor panels came through undamaged despite the heat at their level and that the ovens were in operating condition within a matter of days.

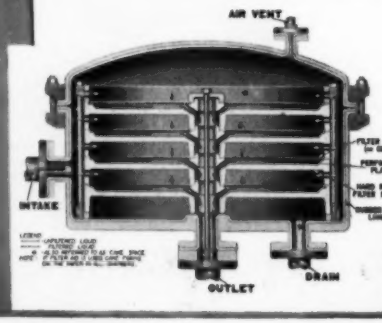
Filter All Plating Solutions Faster, More Completely in

SPARKLER
Horizontal Plate
FILTERS

Because the filter cake is held horizontally, it is absolutely stable to the end of each filtering cycle. And cycles are longer because the cake retains its porosity longer. That is why the "horizontal principle," as embodied in Sparkler filters, gives you more efficient, low cost, operation. Sparkler filters are pressure-tight and leak-proof, designed for intermittent or continuous operation.

4 Plating Solution Types
1. Rubber-lined for bright nickel
2. Stainless steel for acids
3. All Iron for alkaline solutions
4. All Steel (with Stainless Pump) for chromium

SPARKLER MANUFACTURING CO.
Mundelein, Illinois



Made in Capacities 60 to 10,000 G.P.H.
See your supplier or Write for details
Our Engineering Service is available for any specialized problems.

New directors and officers elected by Moore enameling

At the annual stockholders meeting of The Moore Enameling & Manufacturing Co., held in West Lafayette, Ohio, April 23, the following new directors were elected: Walter B. Moore, chairman; Wm. B. Rodgers; W. M. Pomerene; E. F. Stahl; and H. E. Morgan.

The following officers were elected: Walter B. Moore, president and general manager; E. F. Stahl, executive vice president; Wm. B. Rodgers, vice president; H. E. Morgan, secretary-treasurer; and E. B. Huff, assistant secretary.

PMI president speaks for stampers

Addressing the meeting of the Cleveland District Pressed Metal Institute, attended by more than 200 stampers, at Hotel Cleveland, April 21, Tom J. Smith, Jr., PMI president, stated in part that:

"Grave concern has been expressed with regard to the declining iron ore supplies in the great Mesaba range lying northwest of Lake Superior and there is a possibility that the high grade ores in this field will be worked out in the next decade or so requiring further benefaction of taconite, the mother rock from which nature produces iron ore, in order to extract the lower grade ores in which Mesaba has infinite supplies, a supply that will cost more in finished steel.

"The Pressed Metal Institute, anxi-

ous that alien ore from Labrador or elsewhere shall find its way most economically to the mills of Pittsburgh, Cleveland, Detroit, Chicago and Northern Indiana, notes with regret that again Congress has failed to implement the St. Lawrence Seaway to the midwest and urges reconsideration of the subject at an early date.

". . . . The scarcity trend in metals so pronounced since V-J Day will be further augmented by industrial mobilization and the recovery assistance to be given to Europe, China, Greece, and Turkey.

". . . A loss of 44,000,000 tons of coal, 1,514,000 tons of steel, and $117,200,000 in lost wages has resulted over a dispute involving a welfare fund of $32,000,000.

". . . . Actions by the Federal Trade Commission against the basing point system of pricing, in some ways, are inconsistent because defense plans are tending in the direction of segregation and scattering of industries, possibly underground, whereas abolishment of the multiple basing point system will tend to bring the stampers and fabricators of metal closer to their source of supply and are likely to lead to the concentration of production in close proximity to the supplying mill.

"All these matters, while of vital concern to stamping manufacturers, have great interest for other industries as well and if the Pressed Metal Institute's success in its continuing the battle against the scarcity and distribution inequalities in the metal fields prevails, then other industries will benefit accordingly," stated Smith.

Bendix stockholders approve purchase of Rand Washing Machine

Stockholders of Bendix Home Appliances, Inc., approved the purchase of H. J. Rand Washing Machine Co. of Cleveland, Ohio, at their annual meeting in South Bend, Ind., April 13.

The Bendix management announced that the purchase will provide control of patent applications relating to the Rand-type washer, which is believed to be radically different from any washing machine now available.

All officers and directors were reelected at the meeting.

John Weed Whittemore is new ACS president

The selection of John Weed Whittemore, of Virginia Polytechnic Institute, as president of the American Ceramic Society, and the selection of Cincinnati as the location for the 1949 convention, should give further encouragement to southern ceramic interests and lead to complete cooperation from the new "industrial" South.

New production records set by plumbing industry in 1947

A study of Bureau of Census data reveals that 1947 total production of enameled bathtubs and enameled plus vitreous china kitchen sinks broke all previous records, according to the Plumbing and Heating Industries Bureau.

Production of enameled cast iron bathtubs in 1947 was 49.4% greater than 1946, while output of cast iron lavatories was 73.1% greater.

Despite the high production, the demand for plumbing fixtures continues strong, the report states.

University of Texas offers course in porcelain enameling

With a shortage of technically trained men in the porcelain enameling industry, management will be interested to know that the Department of Ceramic Engineering, University of Texas, is offering a regular 4-year course leading to the degree of Bachelor of Science in Ceramic Engineering.

According to F. K. Pence, chairman and director of the department, the university's standards are in every way equal to those of similar departments in other leading ceramic schools.

Said Mr. Pence, "Our department is designed as the headquarters for development in industry for the entire Southwest, since we include not only a teaching department but a research bureau as well."

Robertshaw-Fulton official to retire in July

W. D. Crouch, a pioneer in the thermostat field, has announced his intention to retire July 31 from the position as general manager, Commercial and Industrial Division, Robertshaw-Fulton Controls Company, Youngwood, Penn.

Responsibilities as general manager of the division will be assumed by E. J. Horton, assistant to the president, it was stated.

R&M names sales promotion manager

Roberts & Mander Corp., Hatboro, Pa., has announced the appointment of Herbert E. Fritz as sales promotion manager. The report states that he will spend much time in the field

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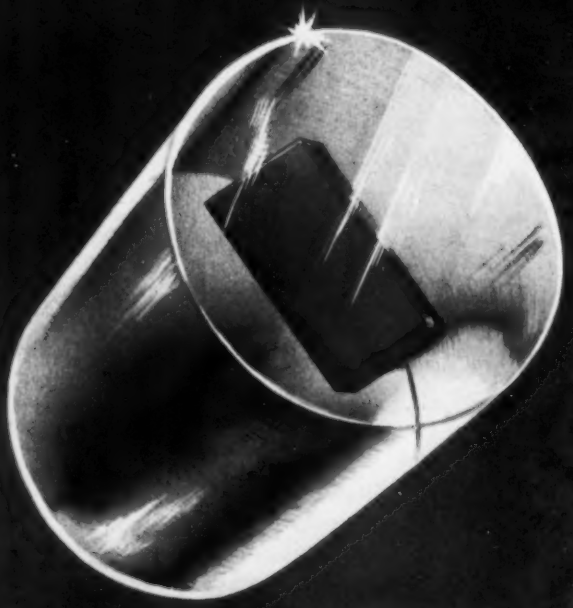
Tipped!



*Continuous smelting . . . an exclusive PEMCO process . . . is the only commercial method of producing ground or cast cost-in commercial quantities-free positive uniformity. Pemco Continuous Smelters Patents Reg. in U.S. Patent Office Nos. 2323920—2263069—2263070—2248877—2137931—2137930

This little plug of plastic will hold

the history of the piece of porcelain enameled steel firmly imbedded in its center. Today and tomorrow it will be the same and available for microscopic analyses. Facts discovered under laboratory experimentation and study can be verified ANYTIME. The true value of the finish can be learned.

A simple little idea, yes, but it helps enormously in the production of frits of uniform* high quality and unvarying performance. It is the "little things," usually ignored, in which Pemco insists on perfection; little things that help explain Pemco Quality—The World's Finest frits. This is but one of them.

PEMCO CORPORATION

Baltimore 24, Maryland

Always Begin With a Good Finish

An early headache becomes a practical movable building

(Continued from Page 22)

York, and New Jersey. About this time, however, the Benjamin Company discontinued enameling work for everything but reflectors, and it became necessary to hunt around for a new manufacturing source. Arrangements were made with Louisville Enamel Products Company, through Pierre McBride, its president, to handle the production, with the structural parts being fabricated across the river by American Car and Foundry Company.

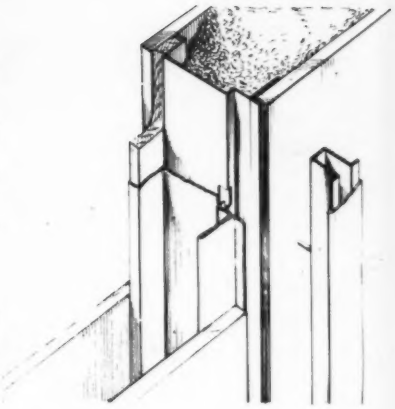
White Castles should be "white"

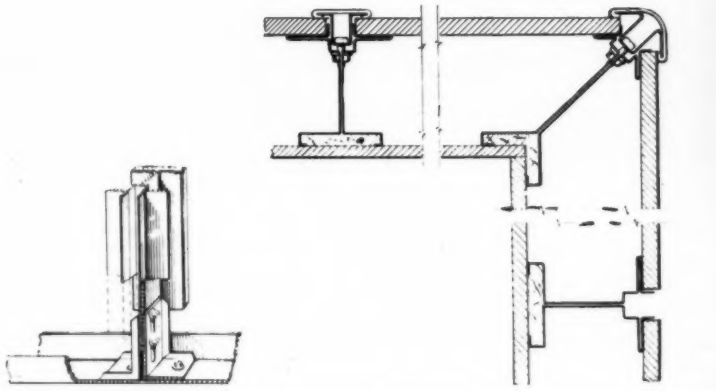
Prior to this time, the exterior enamel had been the conventional smooth finish of a grained pattern and a grayish color, looking somewhat like marble. This had been done because a white smooth-finish enamel would have been blinding to the eyes in the sunlight.

Billy Ingram, however, wanted a White Castle to be white, and so the buildings that have been built since, beginning with those in 1932, have used a ripple finish on the exterior enamel which eliminates the undesirable glare without sacrificing the beauty of the whiteness. The interior, of course, has always been a smooth white finish.

A try at the building business

About this time there was considerable interest being displayed in the development of a porcelain enamel building by other concerns, for it was evident that if this structure solved the building problems of the White Castle System it would do the same for others, particularly those companies operating such units as gasoline filling stations. As a result, we made a deal with the Ohio Oil Company for three filling stations, which were also built under the supervision of the Louisville Enamel Products Company and erected in 1932 in Columbus, Sprinfield, and Bowling Green, Ohio.





The detailed drawings of building details, right and below, show the method of installation of architectural porcelain enamel panels for White Castles.

The elasticity of our method of construction was apparent in these three buildings. The main structure was octagonal, with an octagonal canopy extending around the entire building. A tower began just above the canopy, constructed of red enamel steps showing seven different shades of red from the deepest maroons to carmines and pinks. This tower reached to a height of fifteen feet, becoming narrower toward the top and finally supporting a cupola made to look like a lighthouse. The production of these buildings was proof that the architecture, shape and color design obtainable through our method of construction were practical.

For two or three years, an effort was made to market our building to other concerns, two more being sold

The White Castle method of construction can produce other modern buildings.

CANDIDATE FOR BEST LINING BRICK OF THE YEAR

MORE PRODUCTION LESS DOWNTIME

COMPLETELY VITRIFIED FOR LONGER WEAR . . .

HAND ROLLED GRINDING BALLS

Made from specially developed vitreous porcelain body and hand rolled for faster, uniform grinding. Mill tested and individually inspected before shipment to you.

●

MILL LINING BRICK

Low in glass content, McDanel Mill Lining Brick gives maximum resistance to wear and long, satisfactory service. Complete size range to fit every size mill.

●

MILL HEAD ASSEMBLIES

Be sure to specify McDanel Mill Head Assemblies on your new mills. No metal can contaminate your mill charge with these patented covers. They are tops for uniformity of batch and long service.

●

METAL COVERED GRINDING JARS AND MILLS

Protected with heavy gage steel jacket McDanel Metal Covered Grinding Jars and Mills are easy to handle, easy to clean, discharge rapidly and stand up under long hard usage.

Try McDanel Mill Lining Brick on your next re-lining job. Their longer service will more than prove to you that they reduce expenses and downtime—give more production per installation at less cost.

Made with the same exacting care as McDanel Lining Brick, McDanel Fill-in Brick simplify re-lining jobs, make the mason's work easier, faster.

McDanel Lining Brick and Fill-in Brick will get your vote once you put them to the test in your plant. All standard sizes available. Write for catalog today.

CHICAGO VITREOUS ENAMEL PRODUCT CO., Cicero, Illinois.
Exclusive representative for the Enamel Industry

REFRACTORY PORCELAIN COMPANY BEAVER FALLS, PA.

COMPLETE *Finishing* SYSTEMS

for ENAMEL • LACQUER • PAINT

The illustrations above show the interior of the Final Coat Hydro-Filter Spray Booth and a general view of the Final Coat Spray Booth and Drying Oven, which were installed in an open craneway. The Complete Mahon Installation at the Ford Truck and Bus Plant includes Metal Cleaning and Rust Proofing Equipment, Dry-off Ovens, Prime Coat Spray Booth and Drying Oven, Final Coat Spray Booths and Drying Oven for Small Parts, Final Coat Spray Booth and Drying Oven for Truck Cabs and Panel Bodies, Filtered Air Supply System for All Spray Booths, and a common Sludge Tank where the overspray from the several Spray Booths is deposited for reclamation or disposal.

Ford Truck Installation

Here is another typical example of Mahon planning and engineering. This Complete Finishing System was installed by Mahon in the Ford Truck and Bus Plant under conditions of restricted head room and other restrictive physical characteristics of the building. Part of the system was installed in an open craneway to obtain an efficient operating layout. What Mahon has done in hundreds of manufacturing plants throughout the world, he is prepared to do for you also. If you are confronted now with a finishing problem involving new equipment, do not hesitate to call on Mahon engineers . . . remember, that twenty-seven years of experience in this highly specialized field, together with constant research and development, have endowed Mahon engineers with a wealth of technical knowledge and practical know-how not available to you elsewhere. See Mahon Insert in Sweet's Mechanical Industries File for complete information, or arrange consultation.

THE R. C. MAHON COMPANY

HOME OFFICE and PLANT, Detroit 11, Michigan • WESTERN SALES DIVISION, Chicago 4, Illinois

Engineers and Manufacturers of Complete Finishing Systems including: Metal Cleaning Machines, Rust Proofing Machines, Dry-off Ovens, Hydro-Filter Spray Booths, Filtered Air Supply Units, and Drying and Baking Ovens. Also Paint Reclaiming Units, Hydro-Foam Dust Collectors, and many other Units of Special Production Equipment.

MAHON

in 1934 to Midcontinent Petroleum Corporation and erected in Winfield, Kansas, and Burlington, Iowa. However, Mr. Ingram abandoned the idea of marketing the building soon after that, principally because business conditions at that time were not conducive to prevailing upon potential buyers to spend their money for such a revolutionary idea. Then, too, each prospective customer wanted a different style of architecture and design, all of which required new dies and layout work and engineering, and wanted to try out one building before deciding to order in quantity. A single building, of course, could not be sold at a quantity price, yet the prospects wanted a quantity price for the single building. Inasmuch as he was primarily in the eating house business, Billy did not feel it advisable to finance the development of building for others in a pioneer material and method of construction.

During 1933, new manufacturing connections were made with Brasco Manufacturing Company of Harvey, Ill., the enameling being done by Chicago Vitreous Enamel Product Company, with eight White Castles being produced. That year we changed our basic design, adopting a square building in place of the rectangular building we had built up to date. The square design has been used since that time.

A new factory for buildings and fixtures

In 1934, the White Castle System moved its headquarters from Wichita to Columbus, Ohio, and purchased a factory to begin its own manufacture of porcelain enamel buildings under a division known as the Porcelain Steel Buildings Company. All fabricating is done in our Columbus plant, with the enameling being done at the plant of Davidson Enamel Products Company, Lima, Ohio. All fixtures, from counters to ice boxes and stainless steel griddles are also made in our own shop. When a building is needed in the field, it is loaded complete in a box car and sent to its destination ready to be unloaded and set up.

Manufacturing of buildings was stopped during World War II, and our plant was used for a variety of war subcontract jobs. This year we are again fabricating White Castles, the first of which will soon open for business at Fifth and Cleveland Avenues in Columbus.

Enameling iron sheets have always been used for fabricating the enameled parts of our building, and the stainless steel for our fixtures.

The method we use to attach the panels and decorative features to the steel framing provides a completely water tight joint, at the same time permitting free expansion and contraction of the porcelain enamel, which is necessary for its successful use as an architectural material. All this is accomplished without a single bolt or rivet head being visible on the surface of the building.

Along with the application of a sound deadening and insulating material to the inner surface of the exterior panels, the five-inch space between the exterior panels and inside walls is packed with a standard grade of insulating wool, resulting in a wall that has more than four times the insulating value of 18 inches of masonry. In addition, wood stripping, or furring, is attached to the inside flanges of the steel framing members, breaking the metal-to-metal contact between the inside and outside walls, thus preventing sweating and resulting in an unusually high insulation value throughout.

Twenty years on the proving ground

Compared to buildings of the conventional materials of wood, stone or brick, a modern White Castle requires practically no maintenance. There is no evidence of deterioration in the buildings built nearly 20 years ago, and in those few cases where the exterior has been damaged through some kind of accident, it has been necessary merely to replace the damaged panels. Painting, of course, is eliminated, and the buildings are kept sparkling white simply by the use of soap and water.

The past 20 years have proved to our satisfaction that porcelain enamel has provided the greatest basic advancement in construction in many generations. Certainly it has offered the solution to the problem that faced Billy Ingram in 1922.

The fundamentals of pyrometry

(Continued from Page 26)

acid fumes where it may be necessary.

Protecting tubes should be properly selected and, when placed in service, should be inspected periodically to prevent damage to the thermocouple element. The selection of protecting tube materials for many application conditions is a subject in itself. Literature is available and, when in doubt, it will pay to consult an instrument representative and get his recommendations.

Cold junction compensation (Figure 6)

In the earlier discussion of thermocouples and thermoelectric effect, it was pointed out that the emf produced by a thermocouple is caused not by the temperature at the hot junction, but rather by the difference in temperature between the hot junction and the cold junction.

If copper leads were used to connect the thermocouple to the pyrometer, the cold junction would be located at the thermocouple terminals. In actual practice, however, the cold junction is extended to the pyrometer by using extension leads having the same or similar composition as the thermocouple wires.

With base metal, thermocouple extension leads having the same composition as the thermocouples are generally used. With platinum thermocouples a special alloy lead wire is used, because the cost of running platinum wire to the instrument location would be prohibitive. The special alloy lead wires have similar temperature emf characteristics to the platinum couple over the normal range of cold junction temperatures.

to Page 76 →

Again... it's Welcome to

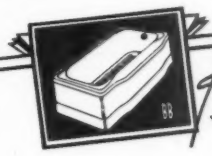
These well known companies are among the latest additions to the membership of the P.E.I. Each will add strength to the enameling industry's national association and each will derive a valuable return from participation in Institute activity.

SEND FOR FREE BOOKLET ON INSTITUTE ACTIVITY

If you operate a porcelain enameling plant, it will pay you to become a member.

This emblem..... **designed by P.E.I. identifies products finished in genuine Porcelain Enamel. It sets these products apart as having the highest quality finish and guides the purchaser in making his selection.**

the P.E.I.



BRIGGS MANUFACTURING CO. PLUMBING WARE DIVISION
DETROIT 11, MICHIGAN
Beautyware
PLUMBING FIXTURES
IN REPLY REFER TO File #7620-A

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PORCELAIN ENAMEL PRODUCTS
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ARTHUR MORGAN, SECRETARY

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W. H. BRETT VICE PRESIDENT

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PORCELAIN ENAMEL INSTITUTE, INC.

1010 VERMONT AVE. N. W., WASHINGTON 5, D. C.

→ *from Page 73*

By the use of suitable leads, the cold junction is transferred to the terminals in the instrument and the emf produced will depend on the difference between the temperature at the thermocouple hot junction and the temperature inside the instrument case.

Figure 6 shows two thermocouples with hot junctions exposed to a constant temperature of 1000° Fahrenheit. In one case the cold junction temperature is 75° Fahrenheit and, with this temperature difference of 925°, the thermocouple produces 28.3 millivolts.

The lower illustration shows the cold junction temperatures is 125° and the temperature difference is 875°, the thermocouple producing only 26.8 millivolts. In both cases the hot junction temperature is 1000° Fahrenheit. If there were no correction for this higher cold junction temperature effect, the lower instrument would read 950° and would be 50° in error.

To provide for this varying cold junction temperature effect a cold junction compensating device is built into the pyrometer, providing accurate temperature measurements regardless of changes in ambient or cold junction temperatures.

In the millivoltmeter or deflectional-type pyrometer this accuracy is obtained by means of a bi-metal spiral which reacts to the cold end temperature changes and moves the indicating pointer up or down scale, independently of the thermocouple emf, to make it read the correct temperature.

In the potentiometer-type pyrometer this same correction is accomplished by placing a nickel coil in the measuring circuit. The resistance of the nickel coil varies with cold junction temperature changes and the readings are automatically corrected. Most modern pyrometers incorporate this automatic compensation feature.

Pyrometers—deflection and null balance types (Figure 7)

There is a fundamental difference between the deflection or millivoltmeter-type and the null balance or potentiometer-type pyrometers. The deflection-type might be compared to a spring scale in its operating principle, since it utilizes a d'Arsonval type galvanometer which deflects in proportion to the millivoltage produced by the thermocouple.

The null balance or potentiometer-type pyrometer functions like a balance scale. The unknown millivoltage produced by the thermocouple is balanced by a known battery-produced potential and the galvanometer functions like the balance-scale pointer to indicate merely when a balance has been obtained. The temperature is indicated by the position of a sliding contact on the slidewire in the potentiometer circuit.

Both types enjoy wide usage today and each have advantages, depending on the application and the degree of measuring accuracy which is required. The millivoltmeter-type has the advantage of lower cost and simplicity, although its accuracy is limited to about 99 per cent. Its accuracy is affected by leadwire length since this varies the resistance in the external circuit. It is not well suited for recording temperatures since the chart width is limited by the galvanometer pointer movement.

The potentiometer is capable of accuracy of 99.8 per cent. It is unaffected by leadwire resistance because it measures potential rather than current flow. Since the pen and pointer are motor driven, the chart and scale lengths are not limited and greater readability results. The potentiometer costs more and requires more maintenance, but it is preferred for most metallurgical applications where maximum accuracy and readability are essential.

The deflection-type pyrometer (Figure 8)

Figure 8 illustrates the elements of a simple deflection or millivoltmeter-type pyrometer. It is essentially a d'Arsonval type galvanometer. The permanent magnet and pole pieces set up a fixed magnetic field. A coil, with indicating pointer attached, is suspended by pivots and jeweled bearings within this field. The thermocouple current passing through the coil sets up an opposing magnetic field. The coil and pointer deflect against hair springs which retard its movement and return it toward zero when the temperature decreases. A shunt and a series resistor are placed in the circuit which, together with the springs, provide calibration means.

Some of the factors affecting lasting accuracy include permanency of the magnet, fatigue of the hair springs, and friction caused by wear of the pivots and jeweled bearings. The simplicity of this type pyrometer is apparent. There are many applications where it can be used to advantage.

Potentiometer null balance circuit (Figure 9)

This is a simple potentiometer circuit, but is not that employed in the actual instrument. It shows the operating principle common to all potentiometers. A dry cell B supplies a constant flow of current through the slidewire resistance C-D. For each position of the slider F, there will be a definite difference of potential between the points C and F. In this branch circuit, the emf of the thermocouple opposes the potential difference between C and F. By moving the slider F, the potential difference between C and F can be adjusted to balance exactly the emf of the thermocouple, and the galvanometer G will show no deflection.

Standard cells provide means to standardize the battery current in the slidewire circuit. This is accomplished by moving switch H to the dotted line position and adjusting rheostat A until galvanometer G shows no deflection. The battery potential impressed on the slidewire is then exactly equal to the standard cell potential. The position of the slidewire contact F, which is mechanically connected to an indicating pointer or pen, indicates the temperature corresponding to the thermocouple potential.

Manual balance (Figure 10)

This illustration depicts a manual balance type potentiometer which

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uses a circuit similar to that just described. To measure a temperature it is necessary to simply turn the large knob until the galvanometer pointer shows no deflection. The temperature is then observed on the large circular scale directly below the galvanometer.

Battery standardization is accomplished by depressing the standardization switch and turning the battery rheostat knob until the galvanometer shows zero deflection. This instrument may be used with a selector switch assembly to indicate, selectively, the temperature of any number of remotely located thermocouples.

Mechanical balance potentiometer (Figure 11)

This view, Figure 11, is a typical potentiometer of the mechanical balance type. It is employed as an indicator or to record one or a number of temperatures. It is supplied also to automatically control temperatures. It has been widely used in the metals industry and provides accurate measurement and dependable automatic control.

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conducting dealer demonstrations, and arranging for trade and consumer shows and other such activities.

Ferro appoints Jaeger Nashville sales manager

Roy H. Jaeger is now manager of the Nashville sales territory for Ferro Enamel Corporation, according to C. D. Clawson, president.

Jaeger served with WPB in St. Louis from 1942 to 1945 as chief facilities officer. Late in 1945, he joined Ferro Chemical Corp., a Ferro Enamel subsidiary, as St. Louis district manager.

New price reduction on fractional horsepower motors announced by G-E

A flat 5 per cent price reduction on certain lines of Apparatus Department products, including fractional horsepower motors, became effective April 15, according to Charles E. Wilson, G-E president. This represents the company's second price reduction on fractional horsepower motors, said the report.

Dean Davis to DeKalb Enameling

L. D. "Dean" Davis, formerly production manager of the architectural division of Chicago Vitreous, joined DeKalb Enameling Co., DeKalb, Ill., as vice president and general manager on May 1. Davis was associated

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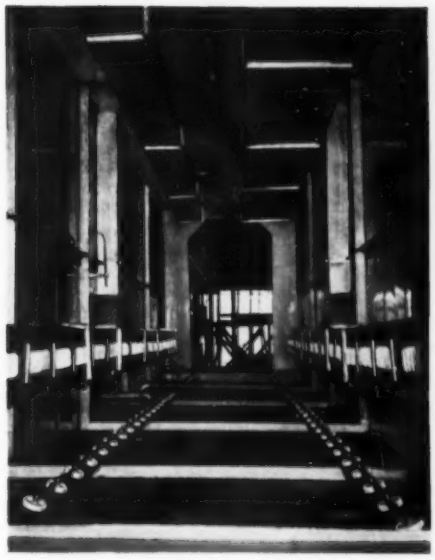

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Pacific Coast enamelers meeting

The Pacific Coast Enamelers Club will meet Friday, June 11, at Scully's Cafe, 4801 Crenshaw Blvd., Los Angeles. The program includes election of new officers and a 40-minute motion picture, "The Romance of Steel," which will present steel in its relation to porcelain enameling.

Commercial standard for sanitary ware now in print

A Commercial Standard for formed metal porcelain enameled sanitary ware was announced by the Commodity Standards Division, National Bureau of Standards, with release of printed edition CS144-47.

Copies are for sale at 10¢ each from Superintendent of Documents, Government Printing Office, Washington 25, D.C. It was stated that a discount of 25% is allowable on orders for 100 or more copies.

Pennsalt sales appointments

Appointment of William D. Wilson as district sales representative in Northern New Jersey and New York City for Special Chemicals Division of Pennsylvania Salt Manufacturing Co., was announced by Joseph J. Duffy, Jr., manager of sales.

Wilson succeeds John M. Davidson who now is Pittsburgh district sales representative, it was stated.

Bettinger Enamel appointments

Bettinger Enamel Corp., Waltham, Mass., has announced the appointment of Bob Plunkett, Jr., as superintendent of its cast iron enameling plant, succeeding Jim Hale.

Mr. Hale has been transferred to superintendent of Porcelain Enamel Products Corp., West Concord, Mass., recently organized by the company to handle all types of porcelain enameled products, it was stated.

Roche is Binks vice president

Burke B. Roche has been elected vice president by the board of directors of Binks Manufacturing Co.,

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